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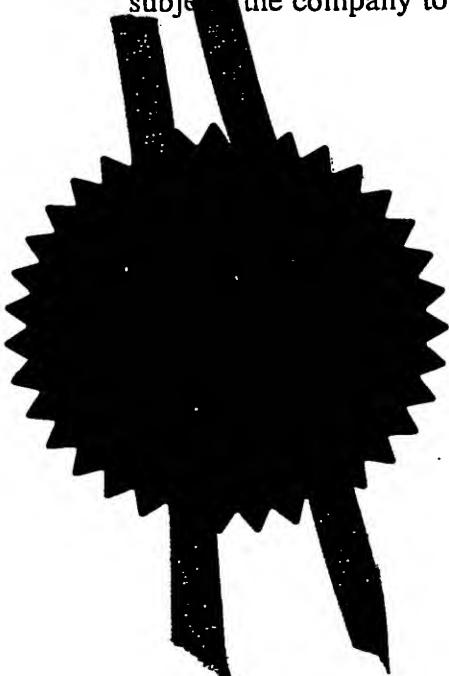
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200303 E945531-2 D00001

P01/7700 0.00-0324363.1

2. Patent application number

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0324363.1

3. Full name, address and postcode of the or of each applicant (underline all surnames)

 Verbus Limited  
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Patents ADP number (if you know it)

08736241001

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention

Building Modules

5. Name of your agent (if you have one)

Abel &amp; Imray

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

20 Red Lion Street  
London  
WC1R 4PQ  
United Kingdom

Patents ADP number (if you know it)

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6. Priority: Complete this section if you are declaring priority from one or more earlier patent applications, filed in the last 12 months.

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7. Divisionals, etc: Complete this section only if this application is a divisional application or resulted from an entitlement dispute (see note d)

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8. Is a Patents Form 7/77 (Statement of inventorship and of right to grant of a patent) required in support of this request?

Yes

Answer YES if:

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- there is an inventor who is not named as an applicant, or
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Patents Form 1/77

9. Accompanying documents: A patent application must include a description of the invention. Not counting duplicates, please enter the number of pages of each item accompanying this form:

Continuation sheets of this form 0

Description 27

Claim(s) 8

Abstract 0

Drawing(s) 21 + 2 (11)

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

Request for a preliminary examination and search (Patents Form 9/77)

Request for a substantive examination (Patents Form 10/77)

Any other documents (please specify)

11. I/We request the grant of a patent on the basis of this application.

Signature(s)

Abel and Imray

Abel & Imray

17/10/03

Date 17/10/03

12. Name, daytime telephone number and e-mail address, if any, of person to contact in the United Kingdom

Mr J E Bardo - 01225 469914

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Building Modules

This invention relates to a building module, to buildings made from such modules and to the construction of 5 buildings using such modules.

There have been many prior proposals for constructing buildings from prefabricated units. In some proposals, panels are prefabricated and transported to a site for assembly into a building. The transport of the panels is 10 reasonably straightforward but the assembly on site involves a considerable amount of labour. In other proposals, an entire building is prefabricated and transported, often with some difficulty. Another option is to make a building from several prefabricated three- 15 dimensional modules and assemble the modules on site, but in that case both transport and assembly tend to be time-consuming and expensive.

It is an object of the invention to provide an improved form of building module.

20 It is a further object of the invention to provide an improved form of building made from such modules.

It is a still further object of the invention to provide an improved method of constructing a building using such modules.

25 According to the invention there is provided a building module having an exterior shape generally of a cuboid having side, end, top and bottom faces, and fabricated from metal, the module being hollow and defining

a space of a size suitable for occupation by a person, the module including fastening elements to allow the module to be fastened to another adjacent module.

Thus the invention provides a module which can be of a size that enables it to be transported but which is able to be fastened to other modules on site to form a larger building in a quick and simple manner.

Preferably there are respective elongate members in the region of each of the eight edges of the cuboid and a plurality of metal panels secured to at least some of the elongate members. The elongate members are preferably of an open or hollow section, for example of hot or cold rolled section, prefabricated section or rectangular hollow section. The elongate members and panels preferably together define a monocoque structure. The elongate members and panels are preferably made of steel. Such a construction enables a module as large as can readily be transported by road to be fabricated with sufficient strength that it is self supporting. Furthermore, when in use the module is fastened to other modules that can enhance their strengths so that a structurally strong building can be formed by fastening the modules together.

In most cases, it will be preferred that there are

~~the~~ panels secured to all of the top and base

may, whether or not they are corrugated, be of composite construction and may for example include insulating material.

Since the module is to form part of a building, it is preferable that it is fabricated with appropriate openings formed therein. The openings may be covered over for the purpose of transporting modules from a factory where they are fabricated to a site where they are to be used in a building; such temporarily closed openings in the module are hereby defined as "open" for the purpose of this specification. For example, one side face or each side face of the module may be partly closed by a panel and be partly open; similarly, one end face or each end face of the module may be partly closed by a panel and be partly open. The partly open face, or one of the partly open faces, may extend from a region at the bottom of the face to a region at the top of the face; that may provide an access route, for example a doorway, into the module for a person; of course, the doorway need not extend to the very top or the very bottom of the face. The partly open face, or one of the partly open faces, may extend upwardly from a region partway up the face. That may for example provide a window opening. One or more openings may also be provided in the top or bottom faces of the module, for example to accommodate a staircase, lift or services within the module.

The module may be fabricated as a completely empty shell and may remain in that state until after assembly

into a building. More commonly, however, it will be preferable to carry out a degree of fitting out either in the factory or on site but prior to assembly into a building. For example, insulation may be added to walls, 5 floors and ceilings, a plywood lining may be provided over the insulation, doors, windows and balconies may be added. Further examples may be electrical, power and lighting cabling systems, heating and plumbing systems, telecommunications systems and other media communications 10 systems. Exterior brickwork may also be added to one or more faces of the module. Ties for holding the brickwork in place may be provided. The ties may be retained in slots in a panel forming a face of the module. A pod containing selected fittings may be installed in the 15 module. For example there may be a kitchen pod containing kitchen fittings or a bathroom pod containing bathroom fittings. Such a pod may occupy a minor part only of the interior volume of the module.

The ability of the module to be fastened to adjacent 20 modules represents a key feature of the invention.

Preferably the fastening elements of the module are suitable for fastening the module to an adjacent module placed alongside and/or to an adjacent module placed end-

to-end and/or to an adjacent module placed above or below an adjacent module.

plurality of storeys, each storey comprising a plurality of modules placed alongside one another.

The fastening elements are preferably provided in the region of the eight corners of the module. As will be 5 clear from the description below, those fastening elements may be the only fastening elements, but there may also be other fastening elements.

In accordance with an especially preferred feature of the invention, the fastening elements are defined by hollow 10 blocks with openings through which connector elements can be inserted. The fastening elements are preferably provided with openings in their top, side and end faces or bottom, side and end faces. The fastening elements are preferably welded to the elongate members. The fastening 15 elements may be in the same general form as corner castings of freight containers and may be in accordance with ISO/TC-104-1161. That facilitates handling of the module between a factory where it is fabricated and its final destination. By using the same fastening elements for transporting and 20 handling the module as are used for securing one module to another an especially advantageous, economical and time saving system is provided.

The connector elements and hollow blocks are 25 preferably arranged such that after a connector element has been inserted into an opening in a hollow block it can be fastened in the opening. Thus the connector element preferably not only locates the module relative to the connector element but also fastens it to the connector

element. The connector elements and hollow blocks are preferably arranged such that after a connector element has been inserted into an opening in a hollow block it can be fastened in the opening by a fastener entering the hollow block through another opening and engaging the connector element. In that manner a very strong and reliable fastening of the connector element to the block can be obtained. The connector elements are preferably fastened in the hollow blocks by fasteners screw threadedly engaging the connector elements in the hollow blocks.

To connect one module to another which may be immediately above or below it, or alongside it, the connector elements preferably include a connector element that has a first part for insertion into an opening in one 15 fastening element of one module and a second part for insertion into an opening in another fastening element of another module. In other cases it is desirable to connect four modules together, for example to connect two modules that are alongside one another to two further modules 20 immediately above them. For that purpose the connector elements preferably include a connector element that has a first part for insertion into an opening in one fastening element of one module, a second part for insertion into an

Gaskets are preferably located between a connector element and a hollow block into which the connector element is inserted. Such a gasket can accommodate expansion or contraction of modules, relieve stresses and isolate 5 acoustic vibration.

Where reference is made herein to a corner casting, it should be understood that the term "casting" is employed because that is the standard terminology. Whilst such elements are usually formed by casting, it is not an 10 essential feature of the invention that they are formed by casting. They may for example be fabricated from sheet steel. Furthermore where reference is made to a corner casting or a block it should be understood that, whilst such an element will usually be formed separately and 15 subsequently fixed to the rest of the module for example by welding, it is within the scope of the invention for the corner casting or block to be formed as an integral part of the rest of the structure of the module.

Standard load handling apparatus is designed to engage 20 corner castings having a centre-to-centre spacing of about 2260 mm. The overall exterior width of the module may be in the range of 2350 mm to 2500 mm, allowing for corner castings at the corners of the module to have a centre-to-centre spacing of about 2260 mm. In many applications, 25 however, it will be desirable for the module to have a greater overall width. In that case it may be desirable to provide one or more additional fastening elements along each top end edge of the module; a single additional

fastening element may be adequate and may be spaced at a centre-to-centre spacing of about 2260 mm from a fastening element at a corner of the module. Alternatively a pair of additional fastening elements may be provided symmetrically

5 on either side of a central plane of the module along a top end edge of the module at a centre-to-centre spacing of about 2260 mm. Similarly, for a module of overall width greater than about 2500 mm, it is desirable to provide a pair of additional fastening elements symmetrically on

10 either side of a central plane of the module along a bottom end edge of the module at a centre-to-centre spacing of about 2260 mm. The additional fastening elements can then be used, for example, to secure a module on a road trailer.

15 It is possible for a module to be less than 2400 mm in width; in that case it may be advantageous for modules to be connected together side-by-side for transport. For example two modules, each of about 1250 mm in width could be connected in this way.

Especially in the case of relatively long modules, it

20 may also be advantageous to place fastening elements partway along top and bottom side edges of the module.

Where the overall width of the module exceeds the range of 2350 mm to 2500 mm given above it is preferably

namely up to about 7400 mm. That can for example facilitate transport of the modules by ship.

Other dimensions of the module may also be matched to those of a freight container. Such containers are commonly 5 of lengths of 20 ft (6058 mm), 40 ft (12192 mm) or 45 ft (13716 mm). Thus the overall length of the module is preferably in the range of 6000 mm to 6100 mm, in the range of 12100 mm to 12300 mm or in the range of 13600 mm to 13800 mm.

10 Preferably the exterior of the module is fitted with a plurality of additional fastening elements for interfacing with an external wall cladding system and/or a roofing system. In that way the addition of a wall cladding system or a roofing system may be greatly facilitated. The 15 additional fastening elements are preferably secured to one or more of the elongate members.

An important aspect of the invention is that the modules are not usually employed individually but rather are fastened together as a multiplicity (a "multiplicity" 20 as used herein refers to three or more) of modules. Thus the present invention further provides a multiplicity of modules for fastening together to form part or all of a building, each module having an exterior shape generally of a cuboid having side, end, top and bottom faces, being 25 hollow and defining a space suitable for occupation by a person.

The modules may all be of the same dimensions but it may also be the case that their dimensions vary, especially

in terms of their widths and lengths. Conveniently, at least the majority of the modules have a width which is approximately one, two or three times a given unit width. For example the given unit width may be 1220 mm, some 5 modules may have a width of about 2440 mm and some modules may have a width of about 3660 mm. Similarly, at least the majority of the modules may have a length which is approximately one, two, three, four or five times a given unit length. In particular applications it may be 10 desirable for a module to be of exceptionally short length and there may therefore be at least one module which has a length which is less than one fifth of the length of the longest module. The short module may be transported with another longer module and result in a combined length that 15 matches a standard length and therefore facilitates transport.

Preferably at least the majority of the modules are of approximately the same height.

Preferably there is further provided a foundation 20 interface having a lower face for resting on foundations and an upper face carrying connector elements for engagement with fastening elements on modules to fasten the modules to the foundation interface. The lower face of the foundation interface can be connected to the foundations in

above in respect of the connector elements connecting two modules together. The foundation interface may be in the form of one or more rectangular rings, opposite ends of a module resting on opposite sides of a ring. An alternative 5 arrangement is to fix the connector elements in appropriate locations directly onto conventional foundations.

Similarly an inter storey interface may be provided for placing between storeys of modules, the inter storey interface having a lower face carrying connector elements 10 for engagement with fastening elements on modules in a storey immediately below the interface and having an upper face carrying connector elements for engagement with fastening elements on modules in a storey immediately above the interface. Again, the connector elements can engage 15 the fastening elements of the modules in the same manner as described above in respect of the connector elements connecting two modules together. The inter storey interface may also be in the form of one or more rectangular rings.

20 Each module of the multiplicity of modules may include any of the features referred to above.

The present invention still further provides a building including a multiplicity of modules as defined above, the modules being fastened together to form part or 25 all of a building with aligned openings in adjacent walls of adjacent modules to allow a person to move from one module to another.

The modules of the building may be fastened together in side-by-side relationship and/or in end-to-end relationship and/or there may be a plurality of storeys of modules, the modules in one storey being fastened to 5 modules in an adjacent upper and/or lower storey.

The invention still further provides a method of constructing a building at a site, the method comprising the following steps:

10 fabricating a plurality of modules at a location remote from the site, each module being generally in the shape of a cuboid and including fastening elements, transporting the fabricated modules to the site, and fastening together the fastening elements of modules to connect the modules together with aligned openings in 15 adjacent walls of adjacent modules to allow a person to move from one module to another.

Preferably the fabricated modules are engaged by their fastening elements to secure them during transport. That facilitates the securing of the modules while they are 20 being transported. Similarly, it is preferred that the modules are engaged by their fastening elements to move them into their final positions at the site.

~~The building that is constructed by the method of the invention is a modular building.~~

Figure 1 is a perspective view of a building module embodying the invention,

5 Figure 2 is a cut-away view of a part of the module of Figure 1 showing the wall construction,

Figure 3 is a cut-away view of a part of the module of Figure 1 showing the floor construction,

10 Figure 4 is a perspective view of a fourth building module being secured to three others during the construction of a building,

Figure 5 is a sectional plan view of one storey of a building formed from eleven modules in each storey,

15 Figure 6A is a perspective view of a first particular exemplary form of module,

Figure 6B is a perspective view of a second particular exemplary form of module,

Figure 6C is a perspective view of a third particular exemplary form of module,

20 Figure 6D is a perspective view of a fourth particular exemplary form of module,

Figure 7 is a perspective view of an open span construction formed from two modules,

Figure 8A is a fully exploded perspective view of a fastener assembly for fastening four containers together at adjacent corners,

25 Figure 8B is a partly exploded perspective view of the fastener assembly of Figure 8A,

Figure 8C is a perspective view of the fastener assembly of Figure 8A,

Figure 9A is an end view of the fastener assembly of Figures 8A to 8C with fastener bolts omitted,

5 Figure 9B is a side sectional view of the fastener assembly of Figure 9A with fastener bolts omitted,

Figure 9C is a plan view of a connector element for 10 use in the fastener assembly of Figure 9A,

Figure 9D is an end view of a lock down plate for use in the fastener assembly of Figure 9A,

Figure 9E is a side view of the lock down plate shown in Figure 9D,

15 Figure 9F is a side sectional view of the complete fastener assembly of Figure 9A,

Figure 9G is a fully exploded perspective view of the complete fastener assembly of Figure 9A,

20 Figure 10 is a perspective view of a module including brickwork on an end face of the module,

Figure 11 is a perspective view of a module with its top not shown and showing certain fittings in the module,

Figure 14 is a perspective view of a module with a much shorter module fastened thereto in end-to-end relationship,

5 Figure 15 is a sectional view through a roof, floor and side of a pair of modules stacked on top of one another,

Figure 16A is a sectional view of an external wall of a module, and

10 Figure 16B is a sectional view of adjoining internal walls of adjacent modules.

Fig. 1 shows a typical module in accordance with the invention. The module 10 is in the shape of a cuboid having opposite end faces 11 (only one of which is visible in Fig. 1), opposite side faces 12 (only one of which is visible in Fig. 1), a top face 13 and a bottom face 14. In the case of the example shown in Fig. 1, the module has an opening 15 in its side face extending from a region at the bottom of the face to a region at the top of the face, and an opening 16 in its end face extending upwardly from a region partway up the face. Panels 15A and 16A are provided to close the openings 15 and 16 respectively prior to final installation of the module. The opening 15 is of sufficient height to allow a person to walk through unobstructed and the opening 16 is of a suitable size and position to provide a window. Similar openings are provided in the other side and end faces not visible in Fig. 1.

The module 10 has a steel monocoque shell structure formed by four horizontal side rails 17, four horizontal end rails 18 and four vertical posts 19, all of open section, and by corrugated steel panels 20 welded between 5 the rails.

At each corner of the module 10, a fastening element in the form of a respective corner casting 21 is provided. Each corner casting 21 is of the kind conventionally found on freight containers and is of hollow construction with 10 external top, side and end apertures 22 providing access into the interior of the casting. Each casting 21 is made in accordance with ISO/TC-104-1161.

Fig. 2 shows one particular internal wall construction that may be employed in the module of Fig. 1. In the 15 example shown steel studding 23 of "L" shaped section is stitch welded to the interior of a steel panel 20, boards of insulation 24 are laid between the studding 23 and plywood 25 is then fixed to the studding 23 over the insulation 24.

20 Fig. 3 shows one particular floor construction that may be employed in the module of Fig. 1. Steel floor joists of "L" shaped section 30 are fixed over the corrugated steel panel 20, boards of insulation 31 are laid between the joists. The bottom of the joists is then covered by a

position together with a module 10C which is directly above the module 10A. Fig. 4 shows a fourth module 10D being lowered into position on top of the module 10B to form a building comprising four modules. The manner in which the 5 modules are fastened together is described below.

Fig. 5 shows one possible layout for a storey of modules, in this case providing bedroom accommodation. The storey shown comprises a single row of modules comprising two sets of four modules 50 with another module 51 interposed between each set and with further modules 52A and 52B at respective ends of the row of modules. The modules 50 within a given set are placed directly alongside one another without any stagger whilst the module 51, which is the same size and shape as the modules 50, is offset 15 from the adjacent sets of modules 50. The further modules 52A and 52B are of a different shape from the modules 50 and 51 being shorter and wider.

Each of the modules 50 may be of the general structure shown in Fig. 1 with the openings 16 in the end faces of 20 the modules providing exterior window openings and the openings 15 in the side faces of the modules allowing the creation of a central corridor 53 through the modules. As shown in Fig. 5, the modules 50 are internally divided by partitions 54 having doors 55 to define the walls of the 25 corridor 53 and bedrooms 56 on each side of the corridor, two bedrooms being thereby created within each module 50.

In the example shown, the module 51 with openings in its side faces aligned with the corridor 53 contains at one

end of the module a staircase 57 allowing access to a lower and/or upper storey through an opening in the roof and/or floor of the module 51. At the opposite end of the module 51 there is a space which may be used for services and/or a lift. In the particular example shown the further modules 52A and 52B are kitchens and each have three windows 58. The storey is shown without any external access but of course it should be understood that if external access is required, that can readily be provided, for example by providing an opening in an end face of the module 51 and forming a doorway in the opening.

Each of the bedrooms created in the modules 50 is shown fitted with a bathroom pod 59. Such pods which may for example include a toilet, washbasin and shower are known *per se* as prefabricated units and will not be described further here.

Figs. 6A to 6D show possible variations of the basic configuration of a module. In Fig. 6A a module 60 with open end faces, a full height opening 61 in one side and a window opening 62 in the opposite side is shown. In Fig. 6B a module 63 with an open side face, an opposite closed side face and two end faces with window openings 64 is shown. In Fig. 6C a module 65 with an open side face,

way of example, it will be understood that many other configurations are possible.

The modules shown in Figs. 6A to 6D are approximately 1.5 times wider than the module 10 shown in Fig. 1. As 5 will be described below, the corner castings 21 of the module are spaced apart by a standard width (about 2259 mm centre-to-centre spacing) to allow them to be carried easily by conventional load-handling apparatus and engaged by fastening devices on said trailers. With a wider 10 module, that spacing can no longer be achieved by the corner castings 21 provided at the corners of the modules and one additional corner casting 68 is therefore provided along each top and bottom end rail 18 at the standard spacing from one of the corner castings 21. That enables 15 the module to be readily handled by load handling apparatus engaging the additional corner casting 68 and the appropriate corner casting 21 on the same end rail 18. A pair of extra corner castings 69 are also provided on the bottom end rails 18 and on the top end rails 18, 20 symmetrically positioned on opposite sides of a central vertical longitudinal plane through the module, at the standard separation (about 2259 mm centre-to-centre spacing). Those extra corner castings 69 allow a module to be fastened to standard fasteners on a road trailer with 25 the module symmetrically placed on the road trailer and to be lifted symmetrically by standard lifting equipment.

It will be understood that the corner castings 68 and 69, not being at corners of the module have fewer

apertures and indeed the castings 69 may have apertures only in their end faces or bottom faces if that is all that is required to secure them to a road trailer and lifting equipment. They are, however, provided in the regions of 5 the corners defined between the top, bottom and end faces and are therefore still referred to as "corner" castings.

In addition to employing modules in accordance with the invention as described above it is possible to use extra modules of special design to suit particular 10 circumstances. For example it may be desirable to create a high open space within a building or on a side of a building and in that case an arrangement of the kind exemplified in Fig. 7 may be employed. The structure shown in Fig. 7 is an open span structure formed from a lower 15 module 71 having a bottom face 72 and end faces 73 but no side faces and no top face, and an upper module 74 having a top face 75 and end faces 76 but no side faces and no bottom face. The modules 71 and 74 may be constructed as rigid structures or they may be formed from separately 20 detachable panels allowing a flat pack style of transport.

It may be noted that each module is provided with corner castings 21 at its eight corners.

An important feature of the described embodiments of the invention is the interlocking between these modules.

in which Figs. 8A to 8C provide an overview of the system and Figs. 9A to 9G provide details of the various parts of the system.

Referring first to Fig. 8A, which is an exploded view, 5 there are shown a corner casting 21A of a lower module, a corner casting 21B of an adjacent lower module, a corner casting 21C of an upper module stacked directly on top of casting 21A of the module with the casting 21A and a corner casting 21D of an upper module stacked directly on top of the module with 10 the casting 21B. As will be understood, only the corner castings of the modules and not the remaining parts of the modules are shown in the interests of clarity.

A connector element 81 comprises in a single casting a central plate part 82, lugs 83A and 83B projecting downwardly from the plate part 82 and lugs 83C and 83D projecting upwardly from the plate part 82. The lugs 83A and 83B pass through apertures 84 in a lower gasket 85 and into the apertures 22 in the tops of the castings 21A and 21B. Similarly the lugs 83C and 83D pass through 15 apertures 86 in an upper gasket 87 (identical to the lower gasket 85) and into the apertures 22 in the bottoms of the castings 21C and 21D.

Once the connector element 81 is installed as described, the corner castings 21A to 21D are positioned as 20 shown in Fig. 8B. Lock down plates 88A and 88B, each carrying a pair of lugs 89A and 89B are then able to be 25 inserted into the end apertures 22 of the corner castings.

Fig. 8B shows the plates 88A and 88B about to enter the apertures.

The plates 88A and 88B have holes 90 which pass through the plates and the lugs 89A and 89B and align with 5 threaded holes 91 in the lugs 83A to 83D of the connector element 81 when the corner castings 21A to 21C are properly assembled together. Then, as a final stage of fastening, bolts 92A to 92D with washers 93A to 93D are passed through the holes 90 and into screw threaded engagement in the 10 holes 91 of the lugs 83A to 83D. The parts are then in the position shown in Fig. 8C.

Figs. 9A to 9G illustrate the assembly just described in more detail.

It will be noted that the fastening system just 15 described is suitable for joining four modules at respective adjacent corners. It will be appreciated that in other parts of the building, for example at a corner, there will be only one upper and one lower corner casting so that a connector plate with only one lug on each side 20 will be required.

Figs. 10 and 11 show certain additional features which may be incorporated in a module according to the invention. For example, if it is desired to provide a brick covering over a glass or metal module, there will be a provision to fit

Fig. 11 also shows how pods, for example a bathroom pod or a kitchen pod, can be inserted through a side opening in the module.

Fig. 12 shows one example of a module, which may for 5 example be the module 52A shown in Fig. 5. Most of the features of the module have been described above and are referenced by the same reference numerals in Fig. 12. A further feature shown clearly in Fig. 12 is the provision along all the horizontal rails of fixing points 120 to 10 which cladding systems, roof support systems or the like may be fixed. In one particular example the module 52A would have the following dimensions:

	overall exterior width, w:	3650 mm
	overall interior length, l:	6058 mm
15	overall exterior height, h:	2900 mm
	spacing between fixing points 120, s:	900 mm
	centre-to-centre distance of additional corner casting 68 from further corner casting on same end rail, d:	2259 mm
20	centre-to-centre separation of extra corner castings 69, x:	2259 mm

Fig. 13 shows a module such as the module 10 of Fig. 1 being placed on a foundation interface ring 130. The ring 130 is placed on an appropriate foundation and locked 25 to it in an appropriate manner known per se. On the upper face of the ring 130 there are upwardly projecting connectors 131 of similar form to the connector elements 81 but with lugs 132 projecting on one side only from a

plate 133 welded to the ring 130. In the example shown the connectors 131 each have a single lug 132 but it will be understood from the description above with reference to Figs. 8A to 8C and 9A to 9G that they may also have a pair 5 of lugs. The lugs 132 have screw threaded holes (not visible in Fig. 13) for receiving bolts that secure modified versions of the lock down plates 88A and 88B described above (the plates being modified such that each 10 carries a single lug only with the bolt passing through the lug and into the screw threaded hole in the connector 131). It will be noted that the ring 130 is dimensioned to match the length of a module so that opposite ends of the module can be fastened to opposite sides of the ring.

Fig. 14 shows a module 140 of similar dimensions to 15 the module 10 described above together with another module 141 of the same height and width, but a much shorter length connected at the end of the module 10. The combination of the two modules preferably has a standard length, for example 40 ft (12192mm). Such an end-to-end 20 connection may provide a useful way of transporting the two modules together even if the short module is subsequently used in a different location in the building.

Fig. 15 shows a section through the floor, ceiling and

roof pan 156 below which are insulating panels 157A, a plywood lining 158A and a plasterboard finish 159A. The insulation panels 157A are held in place by "L" shaped sections 160A welded to the roof pan 156. In a similar way 5 the floor of the upper module 151 comprises a pressed steel corrugated bottom face 161 on which insulating panels 157B are laid and secured in place by "L" shaped sections 160B welded to the steel corrugated face 161. A plywood floor 158B is laid over the panels 157B.

10 Fig. 16A shows a section (in plan view) through one example of an external wall structure. A corrugated steel skin 163 provides the structural strength and on the inside carries insulating panels 157C held in place by "L" shaped sections 160C. A plywood lining 158C is secured over the 15 panels 157C and a plasterboard finish 159C is added. On the outside the steel skin 163 has a layer of insulation 164 and outside that brickwork 165 held to the skin 163 by ties which engage in slots 166 formed in plates 167 welded to the steel skin 163.

20 Fig. 16B shows a section (in plan view) through one example of adjoining internal walls 168A, 168B of adjacent modules. Each wall is of the same construction including a corrugated steel skin 163 which is exposed on its outer face confronting the adjacent module and on its inner face 25 carries insulating panels 157D held in place by "L" shaped sections 160D welded to the skin 163. A plywood lining 158D is secured over the panels 157D and a plasterboard finish 159D is added.

Whilst certain particular embodiments of the invention have been described, it should be understood that these are of course only examples of many different possible arrangements. In the illustrated examples an upper storey 5 of modules is placed directly above a lower storey and the modules in the upper storey are the same size as the modules in the lower storey. It should be understood, however, that this need not be the case. For example, the modules in the upper storey may be bigger or smaller than 10 the modules directly below and/or the modules in one storey may be offset from the modules in another storey. In cases of this kind it is of course desirable for modules to have fastening elements partway along their edges so that the modules in one storey can be connected securely to the 15 modules in another storey.

In the particular example of buildings illustrated, bedroom accommodation is provided. It will be understood that the modules may be employed in a variety of applications including housing, hotels, hostels, hospitals, care homes, and educational, social and leisure facilities, and in commercial, penal or industrial premises. Other applications include basements and cellars, car parking and storage. The accommodation provided by a module can take

The buildings that are formed from the modules can be permanent building structures with a life expectancy as great or greater than those of a conventional building, and they can also easily be extended, converted or modified.

5 Furthermore, if desired, a building can readily be dismantled and the modules moved elsewhere.

It will be understood that appropriate services can also be provided in the modules. Services may be run under floors, above ceilings through specially formed ducts etc.

10 The modules may be provided with openings in appropriate locations to allow services to pass from one module to another.

Claims:

1. A building module having an exterior shape generally of a cuboid having side, end, top and bottom faces, and fabricated from metal, the module being hollow and defining a space of a size suitable for occupation by a person, the module including fastening elements to allow the module to be fastened to another adjacent module.
2. A building module according to claim 1, in which there are respective elongate members in the region of each of the eight edges of the cuboid and a plurality of metal panels secured to at least some of the elongate members.
3. A building module according to claim 2, in which there are metal panels secured on all of the side and end faces of the cuboid.
4. A building module according to any preceding claim, in which there are metal panels secured on the top and bottom faces of the cuboid.
5. A building module according to claim 3 or 4, in which at least some of the metal panels are corrugated.
6. A building module according to any of claims 3 to 5, in which at least some of the panels are of composite construction and include insulating material.
7. A building module according to any preceding claim in which the top panel faces of the module are smooth.

9. A building module according to claim 7 or 8, in which the partly open face or one of the partly open faces extends from a region at the bottom of the face to a region at the top of the face.
- 5 10. A building module according to any of claims 7 to 9, in which the partly open face or one of the partly open faces extends upwardly from a region partway up the face.
11. A building module according to any preceding claim, including a kitchen pod containing kitchen fittings and occupying a minor part only of the interior volume of the module.
- 10 12. A building module according to any preceding claim, including a bathroom pod containing bathroom fittings and occupying a minor part only of the interior volume of the module.
- 15 13. A building module according to any preceding claim, in which the module includes fastening elements for fastening the module to an adjacent module placed alongside.
14. A building module according to any preceding claim, in which the module includes fastening elements for fastening the module to an adjacent module placed in end-to-end relationship.
- 20 15. A building module according to any preceding claim, in which the module includes fastening elements for fastening the module to an adjacent module placed immediately above or below.

16. A building module according to any preceding claim, in which the fastening elements are provided in the region of the eight corners of the module.

17. A building module according to any preceding claim, in 5 which the fastening elements are defined by hollow blocks with openings through which connector elements can be inserted.

18. A building module according to claim 17, in which the fastening elements are provided with openings in their top, 10 side and end faces, or bottom, side and end faces.

19. A building module according to claim 17 or 18, in which the connector elements and hollow blocks are arranged such that after a connector element has been inserted into an opening in a hollow block it can be fastened in the 15 opening.

20. A building module according to claim 19, in which the connector elements and hollow blocks are arranged such that after a connector element has been inserted into an opening in a hollow block it can be fastened in the opening by a 20 fastener entering the hollow block through another opening and engaging the connector element.

21. A building module according to claim 19 or 20, in which the connector elements are fastened in the hollow

~~blocks. The connector elements are provided with connector~~

~~elements which are provided with connector~~

fastening element of one module and a second part for insertion into an opening in another fastening element of another module.

23. A building module according to any of claims 17 to 22, 5. in which the connector elements include a connector element that has a first part for insertion into an opening in one fastening element of one module, a second part for insertion into an opening in another fastening element of another module, a third part for insertion into an opening 10 in yet another fastening element of yet another module and a fourth part for insertion into an opening in a still further fastening element of a still further module.

24. A building module according to any preceding claim, in which additional fastening elements are provided partway 15 along the top end edges of the module.

25. A building module according to any preceding claim, in which additional fastening elements are provided partway along the bottom end edges of the module.

26. A building module according to any preceding claim, 20 including fastening elements that are spaced apart across the module at a centre-to-centre spacing of about 2260 mm.

27. A building module according to any preceding claim, in which the overall exterior width of the module is in the range of 2350 mm to 2500 mm.

28. A building module according to any of claims 1 to 26, 25 in which the overall exterior width of the module is in the range of 2350 mm to 3700 mm.

29. A building module according to any preceding claim, in which the overall length of the module is in the range of 6000 mm to 6100 mm.

30. A building module according to any of claims 1 to 28, 5 in which the overall length of the module is in the range of 12100 mm to 12300 mm.

31. A building module according to any of claims 1 to 28, in which the overall length of the module is in the range of 13600 mm to 13800 mm.

10 32. A building module according to any preceding claim, in which the exterior of the module is fitted with a plurality of additional fastening elements for interfacing with an external wall cladding system and/or a roofing system.

15 33. A building module substantially as herein described with reference to the accompanying drawings.

34. A multiplicity of modules for fastening together to form part or all of a building, each module having an exterior shape generally of a cuboid having side, end, top and bottom faces, being hollow and defining a space 20 suitable for occupation by a person.

35. A multiplicity of modules according to claim 34, the majority of the modules having a width which is approximately one, two or three times a given unit width.

36. A building module according to claim 32, in which the exterior of the module is fitted with a plurality of additional fastening elements for interfacing with an external wall cladding system and/or a roofing system.

37. A multiplicity of modules according to claim 36, in which at least one module has a length which is less than one fifth of the length of the longest module.

38. A multiplicity of modules according to any of 5 claims 34 to 37, in which the majority of the modules are approximately the same height.

39. A multiplicity of modules according to any of claims 34 to 38, further including a foundation interface having a lower face for resting on foundations and an upper 10 face carrying connector elements for engagement with fastening elements on modules to fasten the modules to the foundation interface.

40. A multiplicity of modules according to claim 39, in which the foundation interface is in the form of one or 15 more rectangular rings.

41. A multiplicity of modules according to any of claims 34 to 40, further including an inter storey interface for placing between storeys of modules, the inter 20 storey interface having a lower face carrying connector elements for engagement with fastening elements on modules in a storey immediately below the interface and having an upper face carrying connector elements for engagement with fastening elements on modules in a storey immediately above the interface.

25 42. A multiplicity of modules according to claim 41, in which the inter storey interface is in the form of one or more rectangular rings.

43. A multiplicity of modules according to any of claims 34 to 42, in which each module is according to any of claims 1 to 33.

44. A building including a multiplicity of modules according to any of claims 34 to 43, the modules being fastened together to form part or all of a building with aligned openings in adjacent walls of adjacent modules to allow a person to move from one module to another.

45. A building according to claim 44, including a plurality of modules fastened together in side-by-side relationship.

46. A building according to claim 44 or 45, including a plurality of modules fastened together in end-to-end relationship.

47. A building according to any of claims 44 to 46, in which there are a plurality of storeys of modules, the modules in one storey being fastened to modules in an adjacent upper and/or lower storey.

48. A method of constructing a building at a site, the method comprising the following steps:

fabricating a plurality of modules at a location remote from the site, each module being generally in the shape of a cuboid and including fastening elements.

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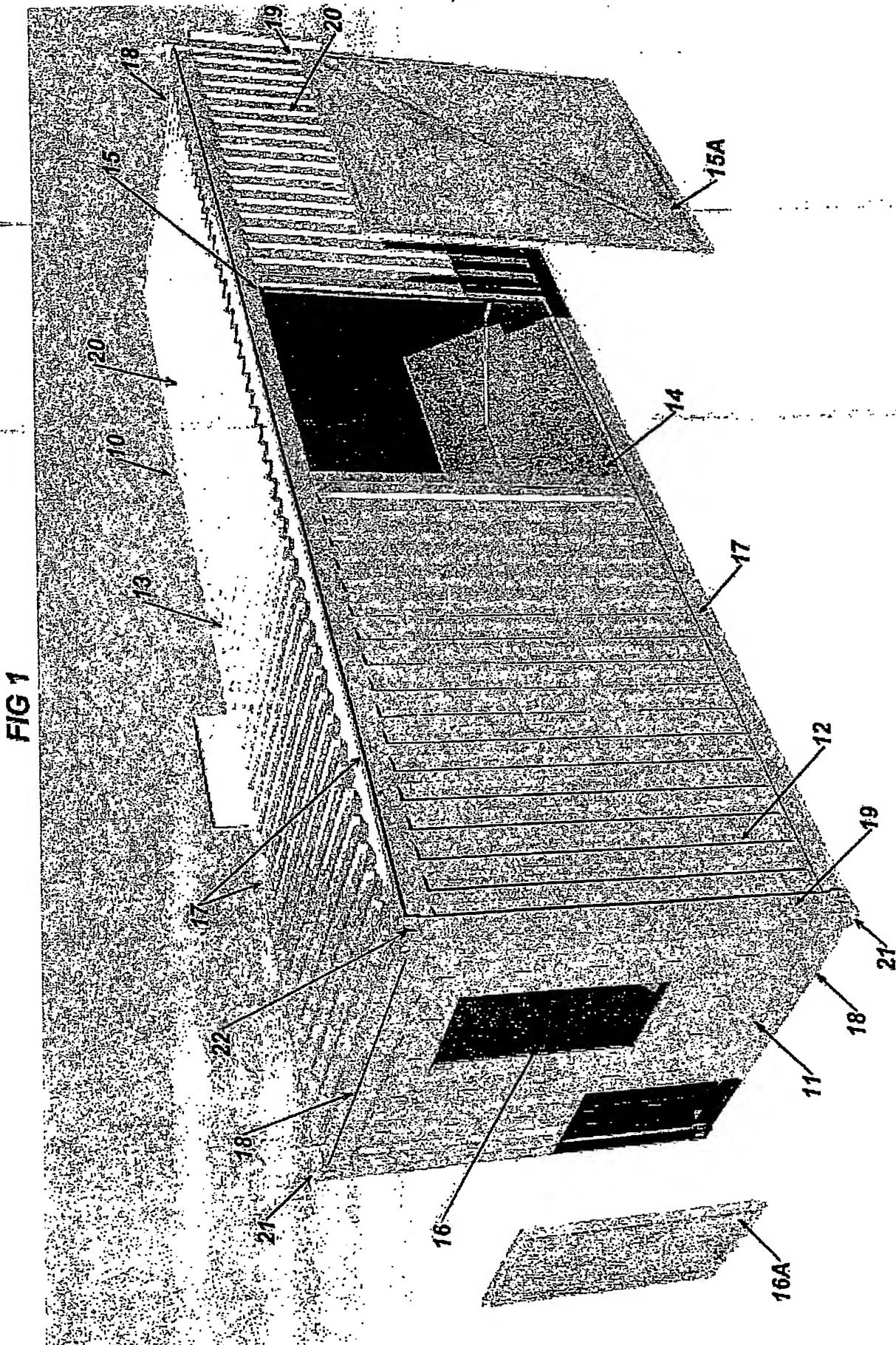
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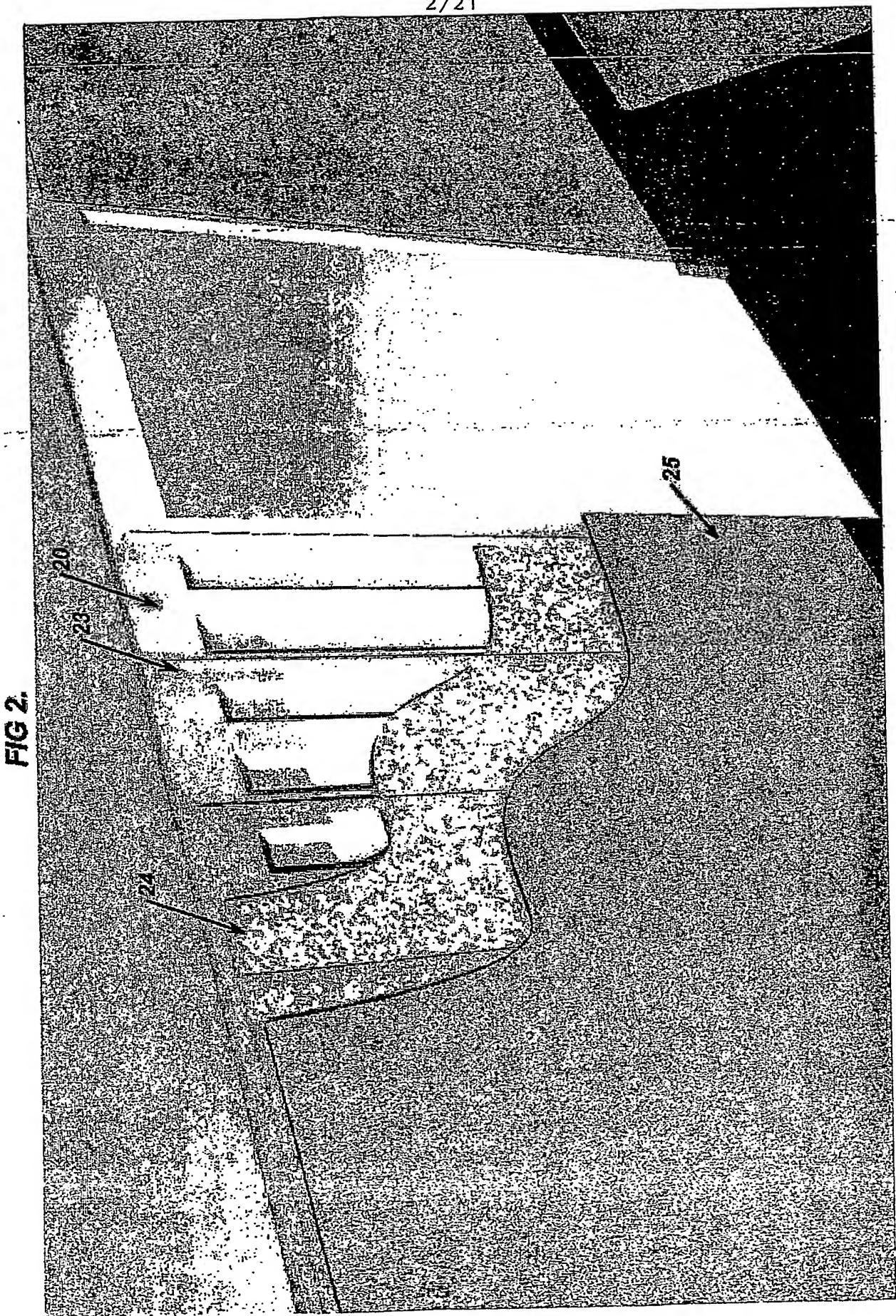
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49. A method according to claim 48, in which the fabricated modules are engaged by their fastening elements to secure them during the transporting step.

50. A method according to claim 48 or 49, in which the modules are engaged by their fastening elements to move them into their final positions at the site.

51. A method according to any of claims 48 to 50, in which the building that is constructed by the method is in accordance with any of claims 44 to 47.





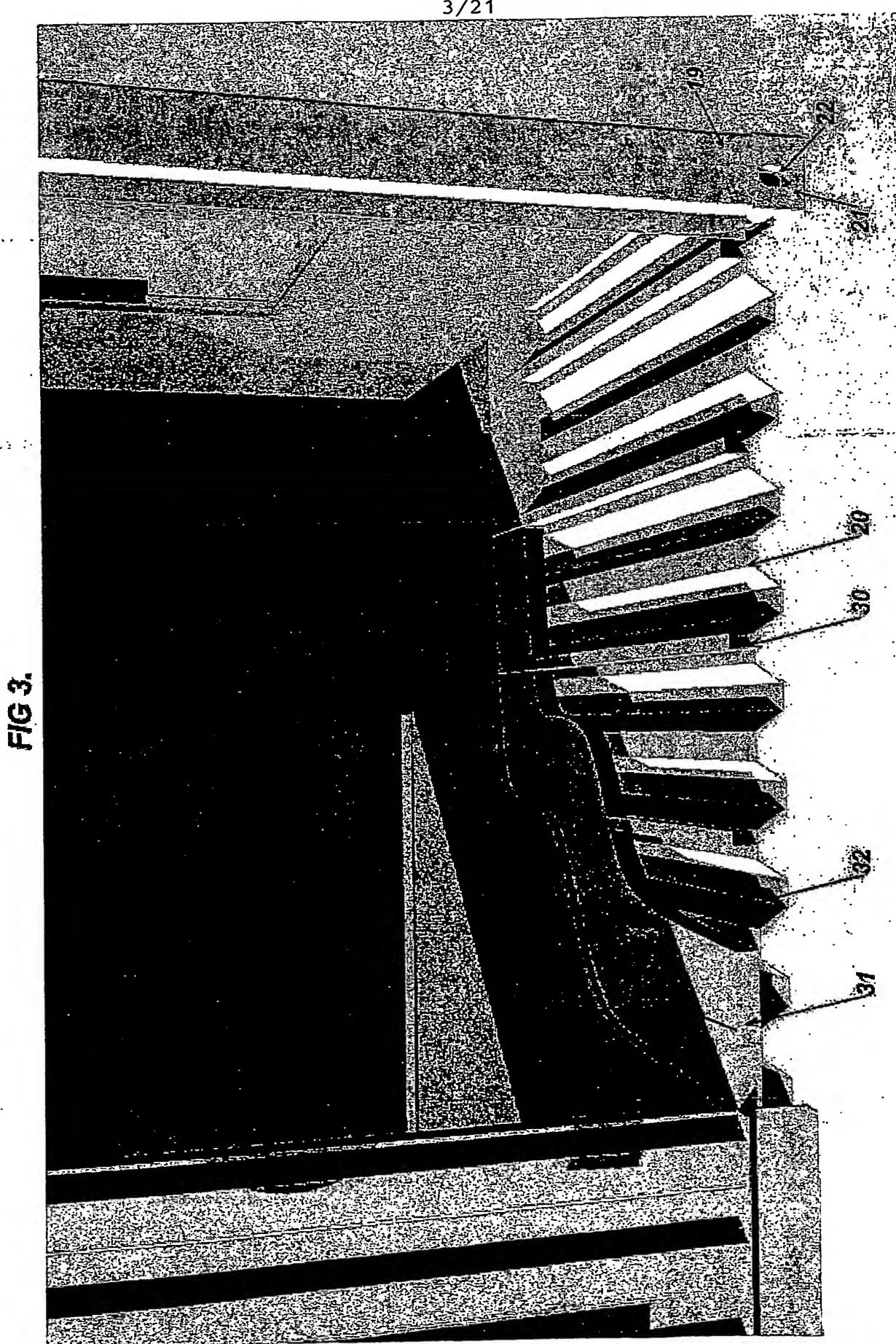


FIG 3.

10D

FIG 4.

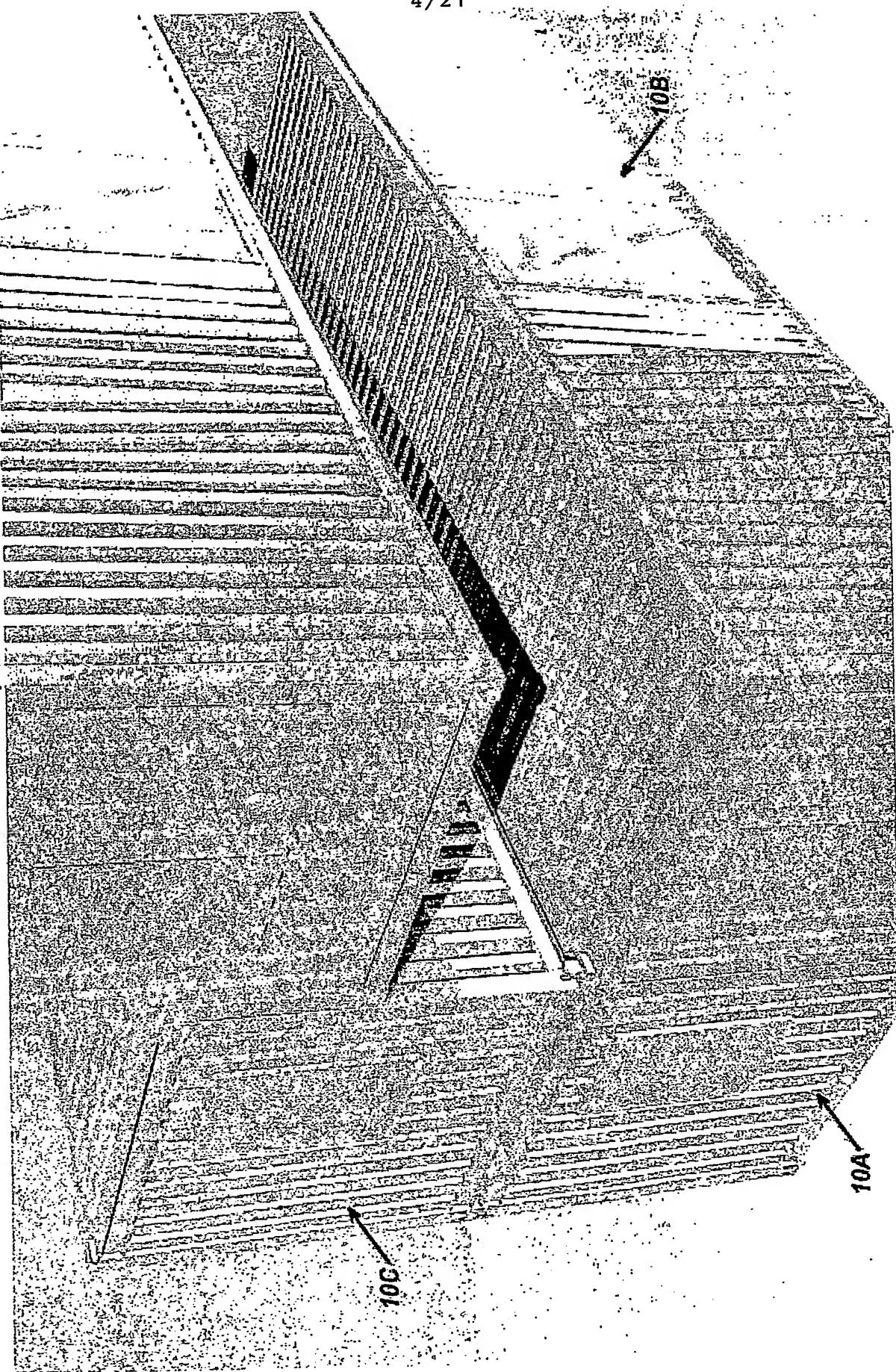
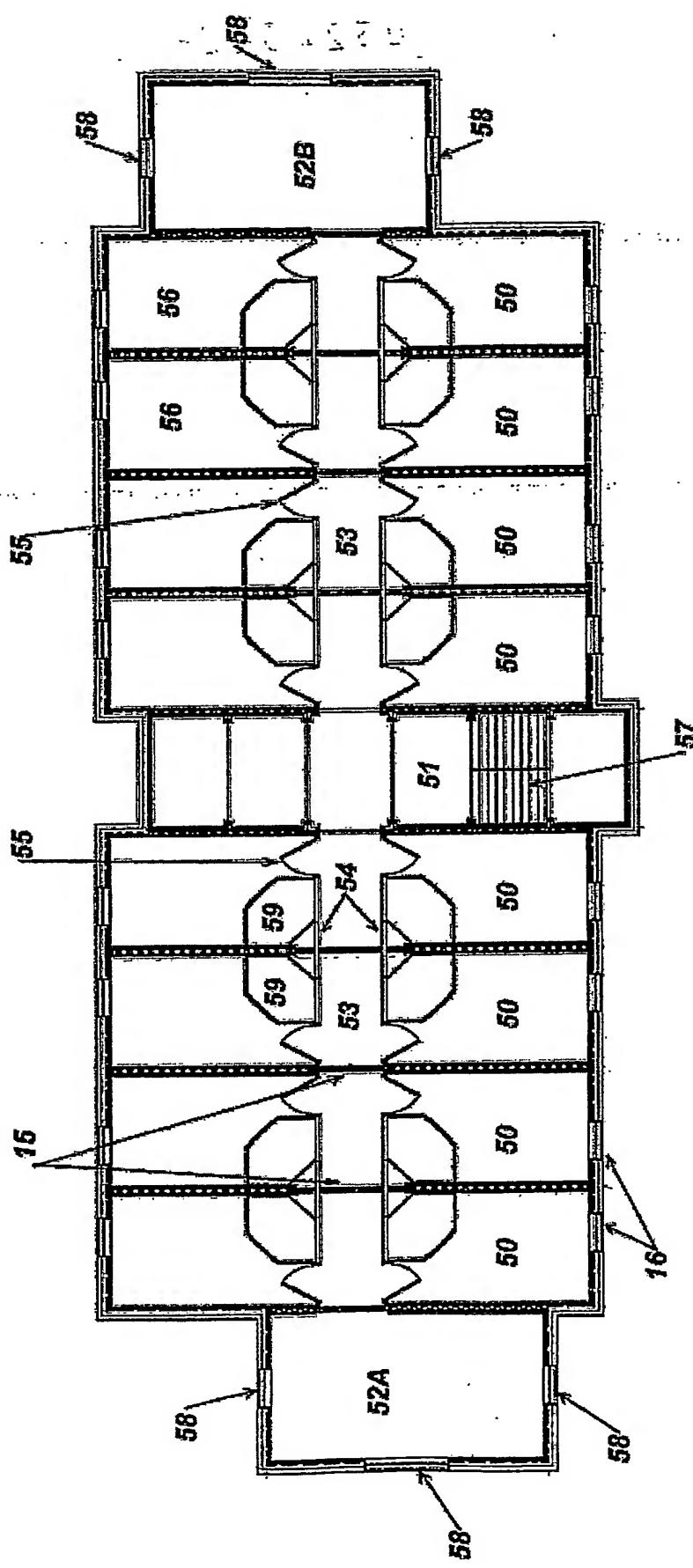


FIG 5



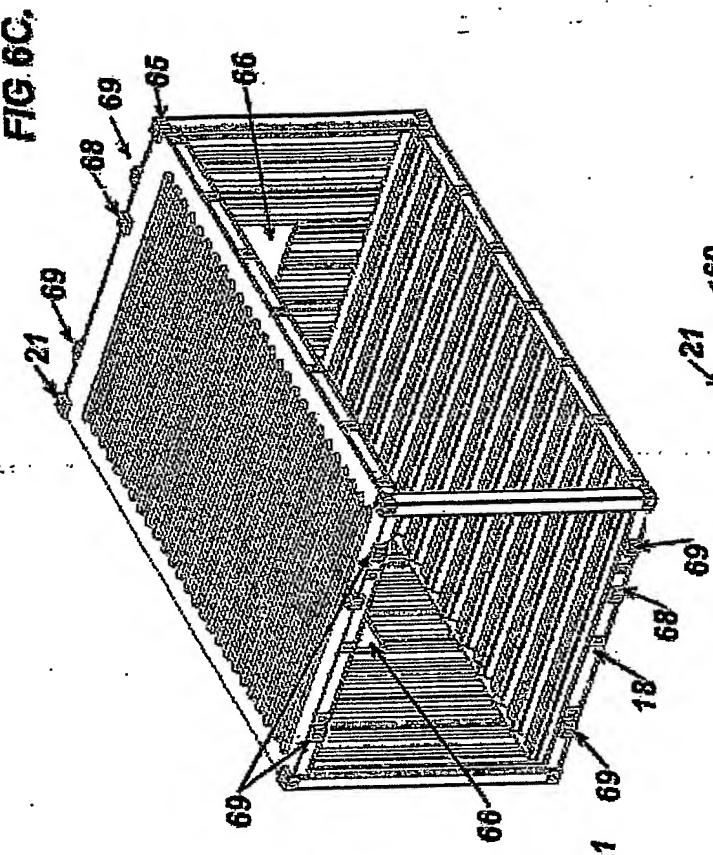


FIG 6A.

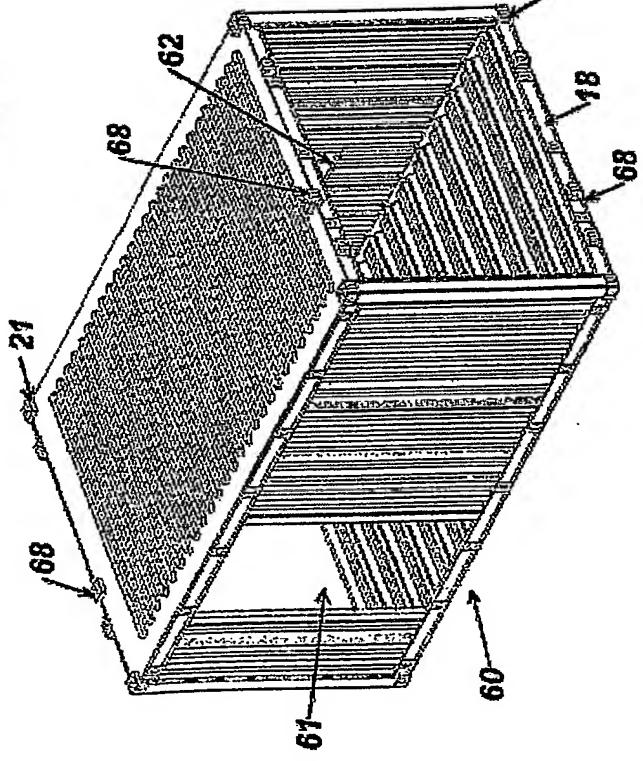
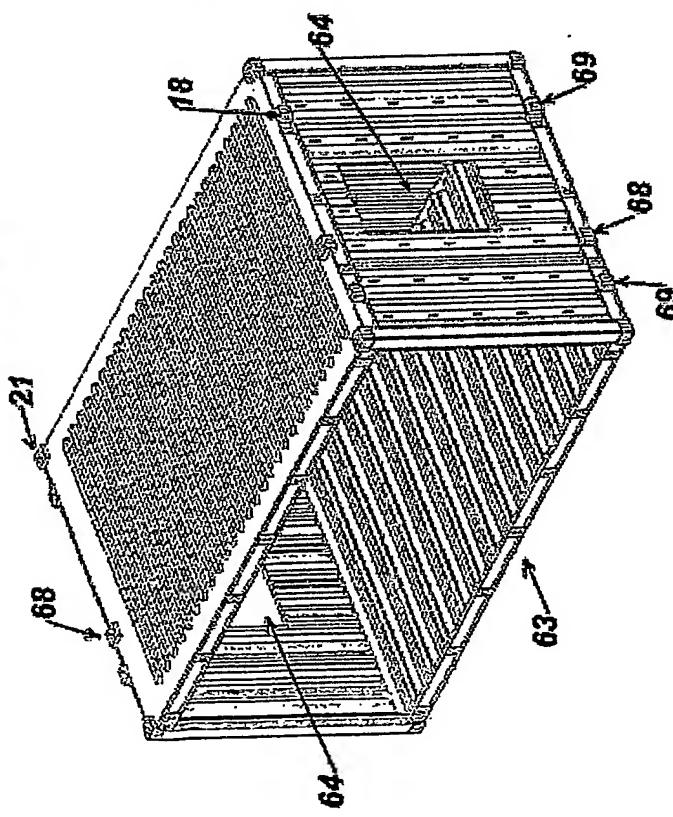


FIG. 6B.



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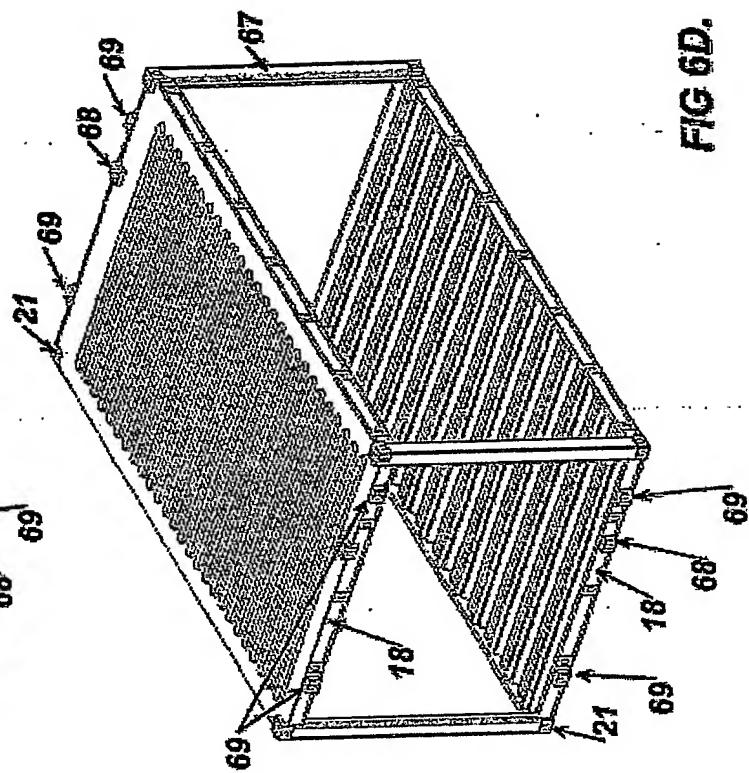


FIG. 6C

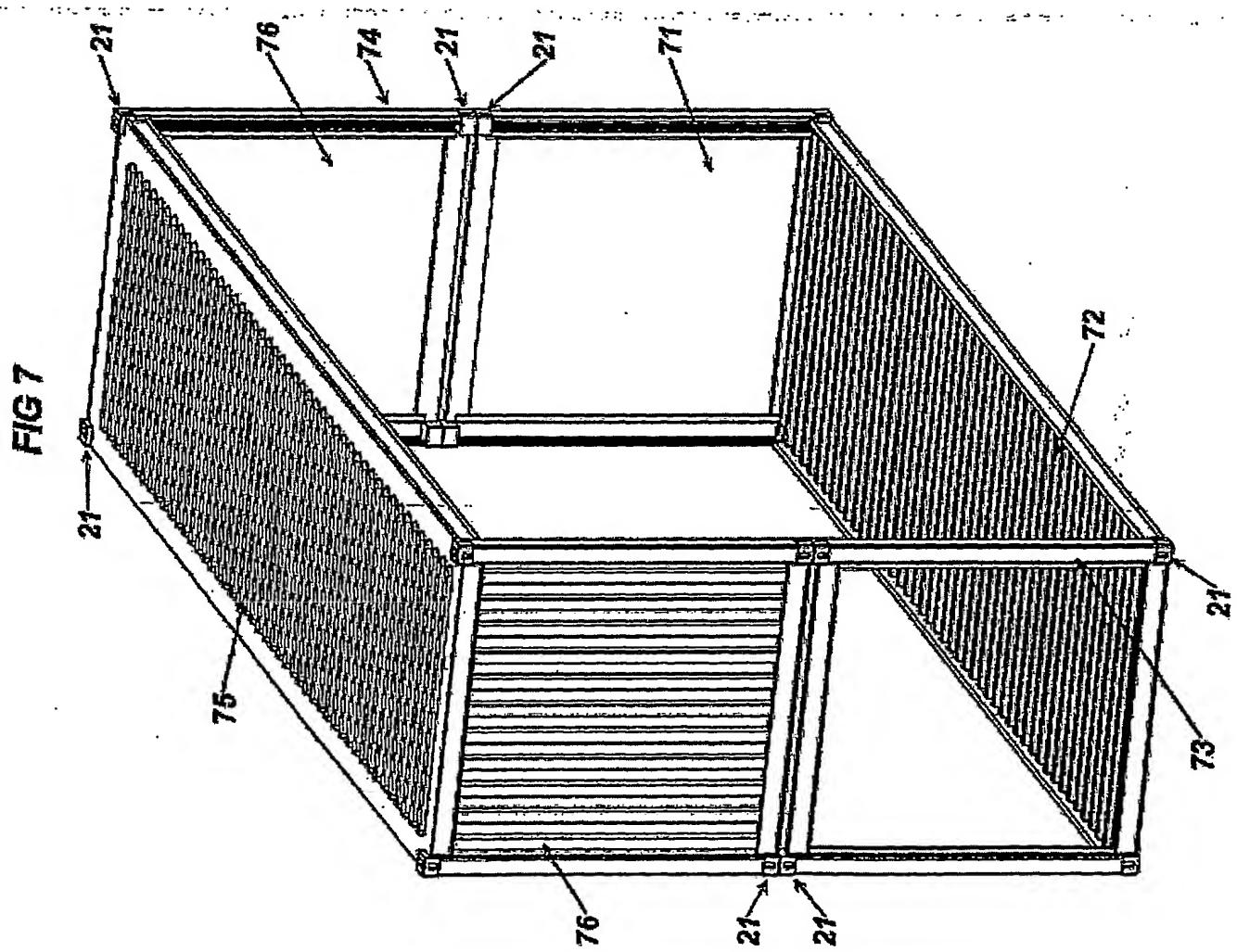


FIG 8A.

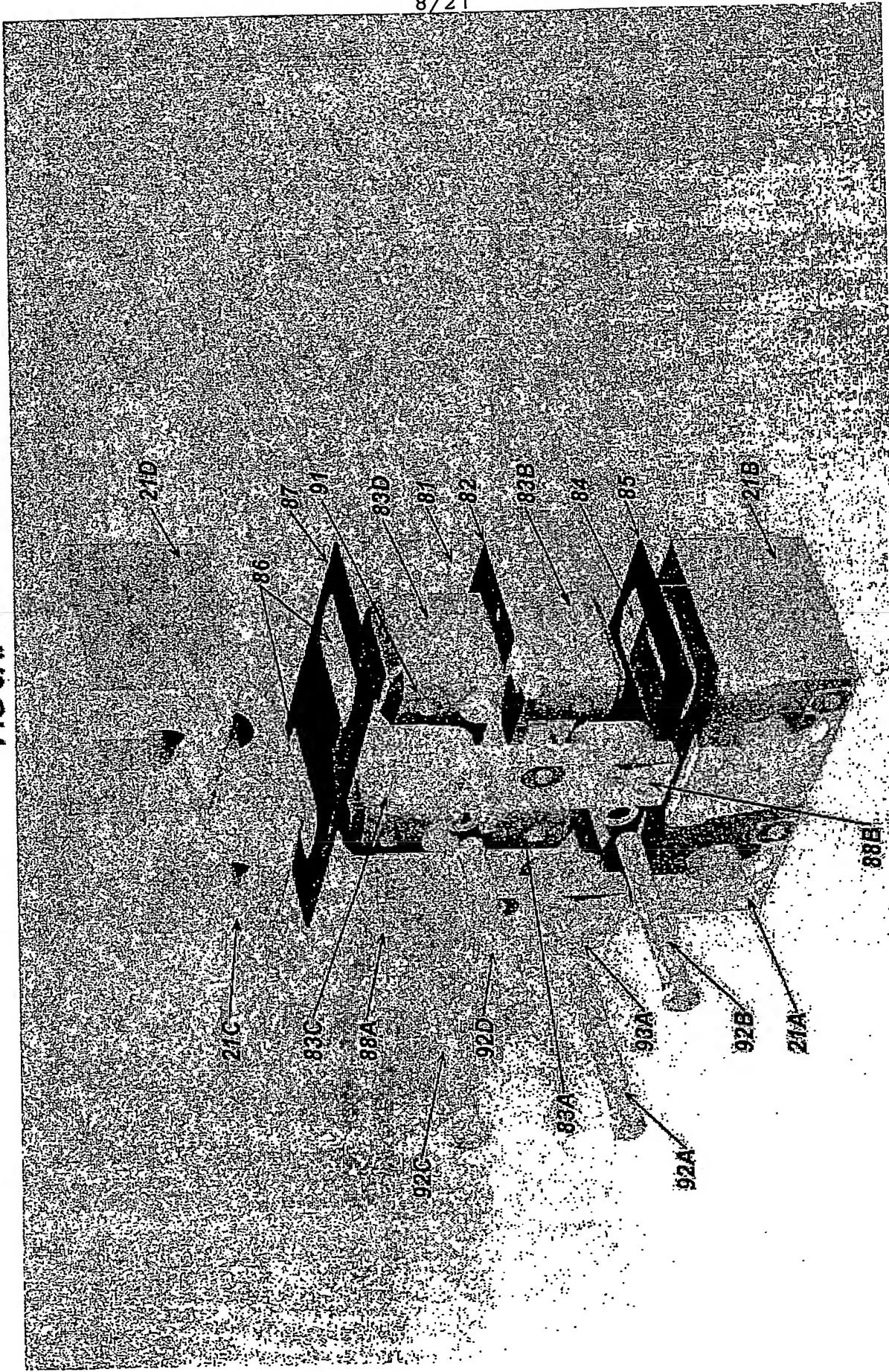
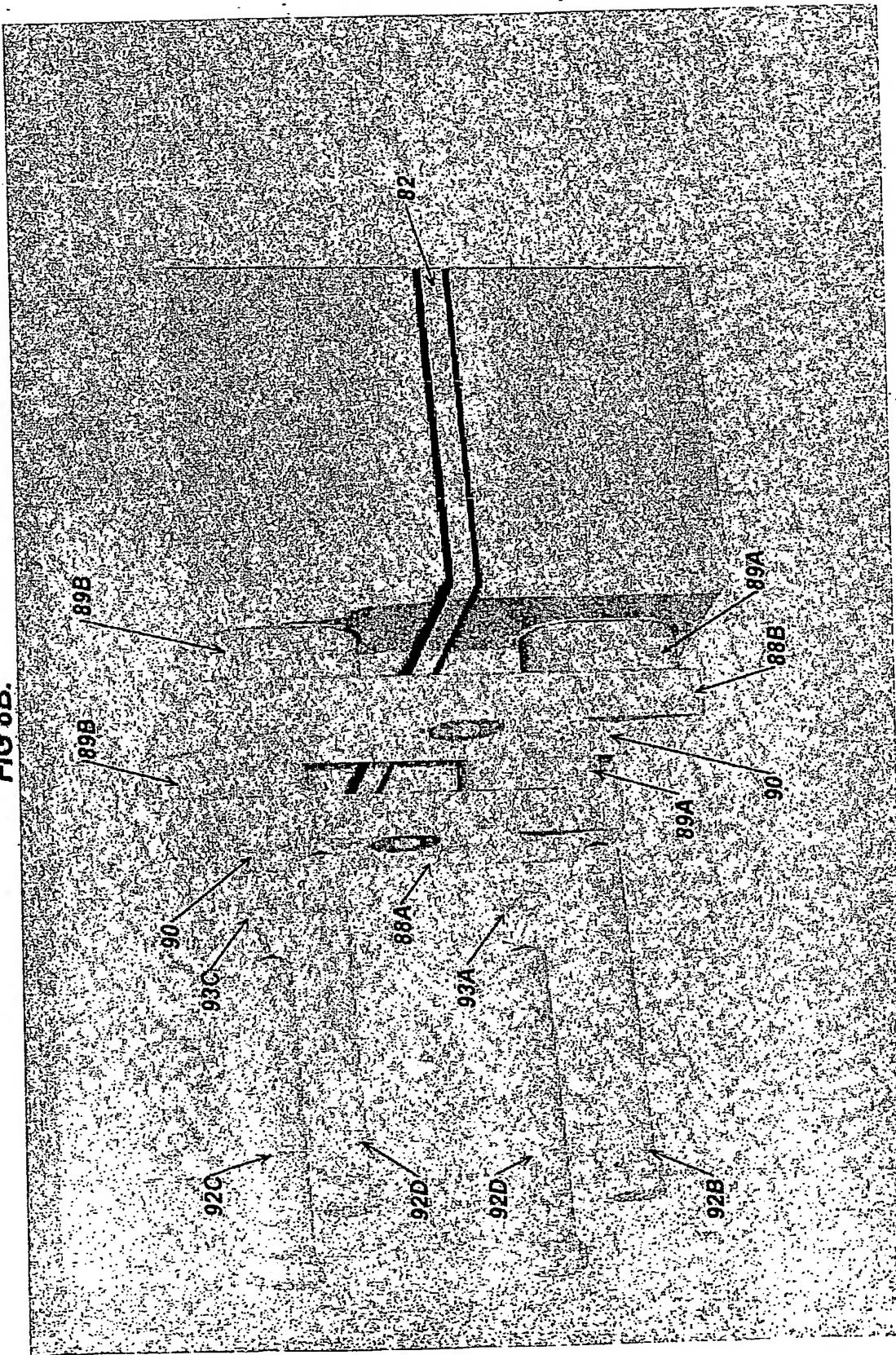


FIG 8B.



10/21

FIG 8C.

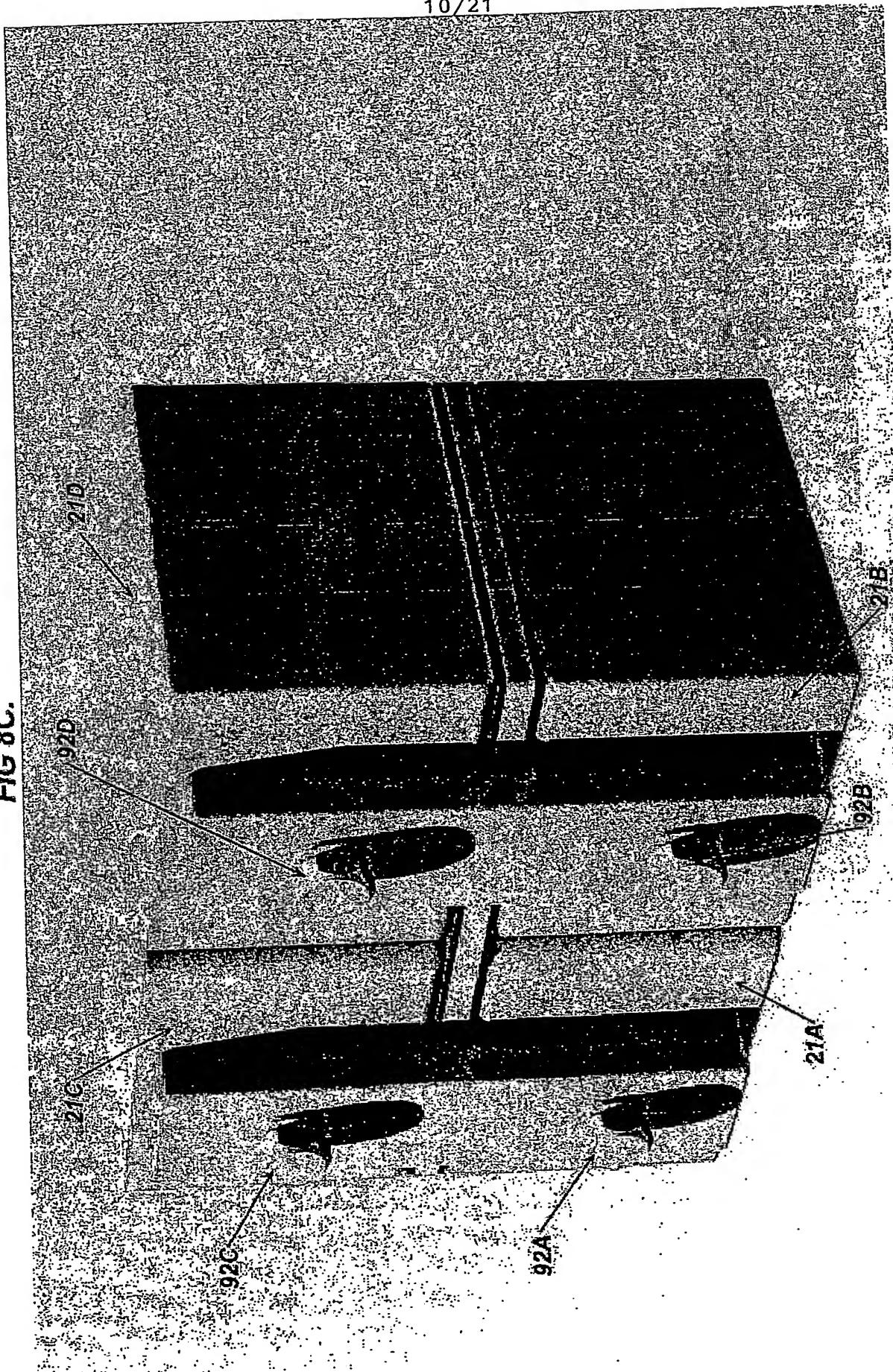


FIG 9B.

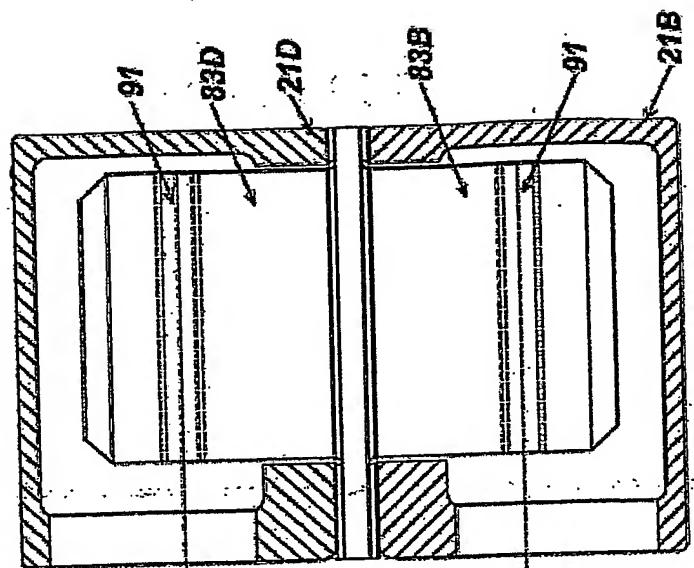


FIG 9A.

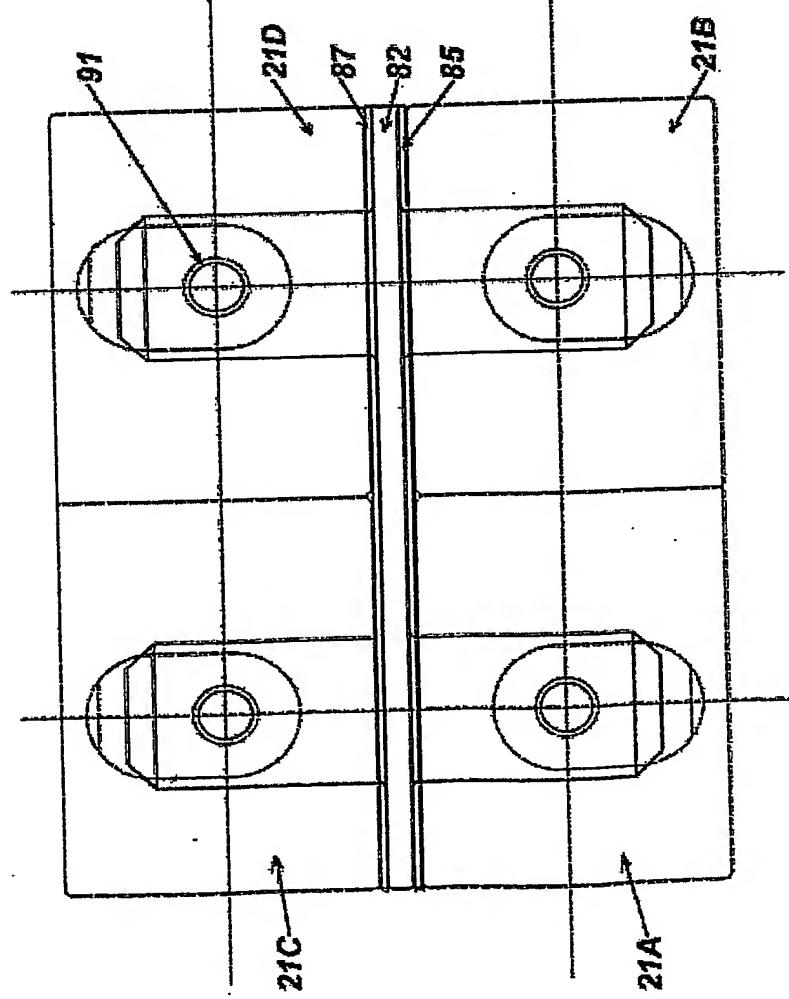


FIG 9D

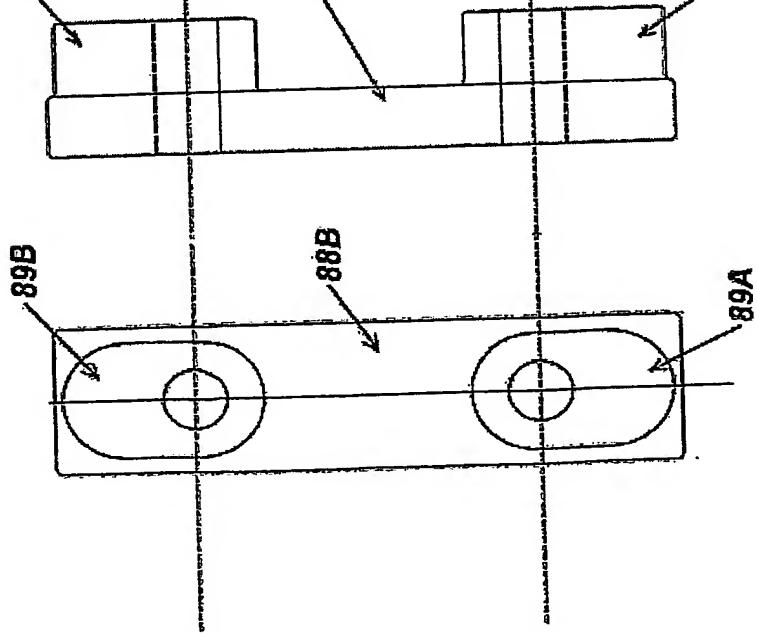


FIG 9E

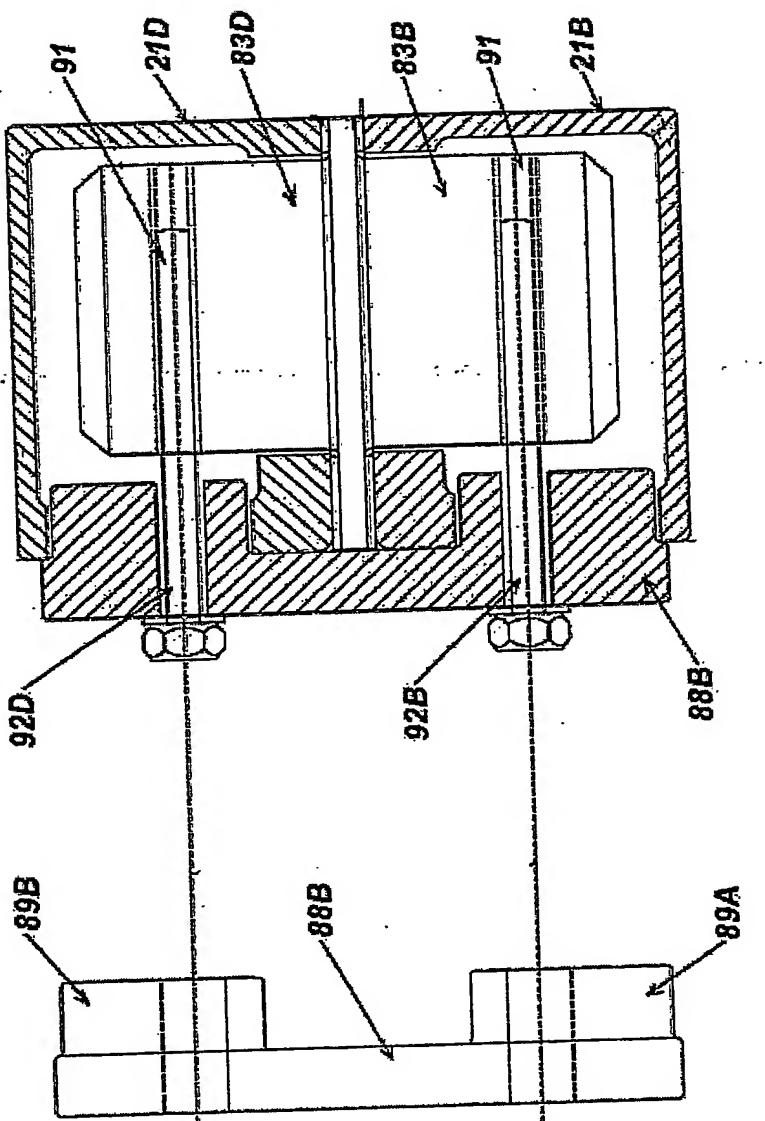


FIG 9E

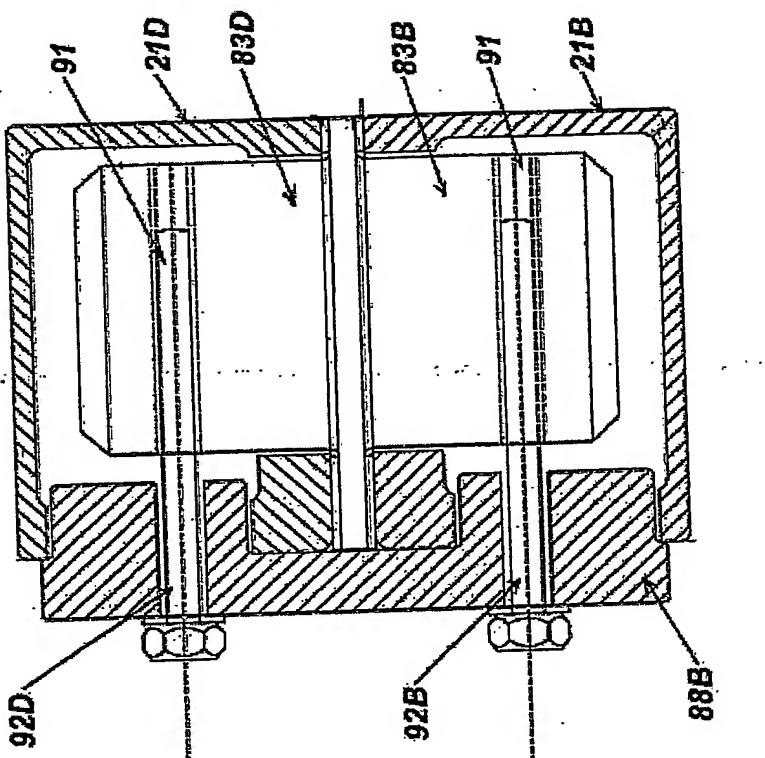


FIG 9F.

FIG 9C.

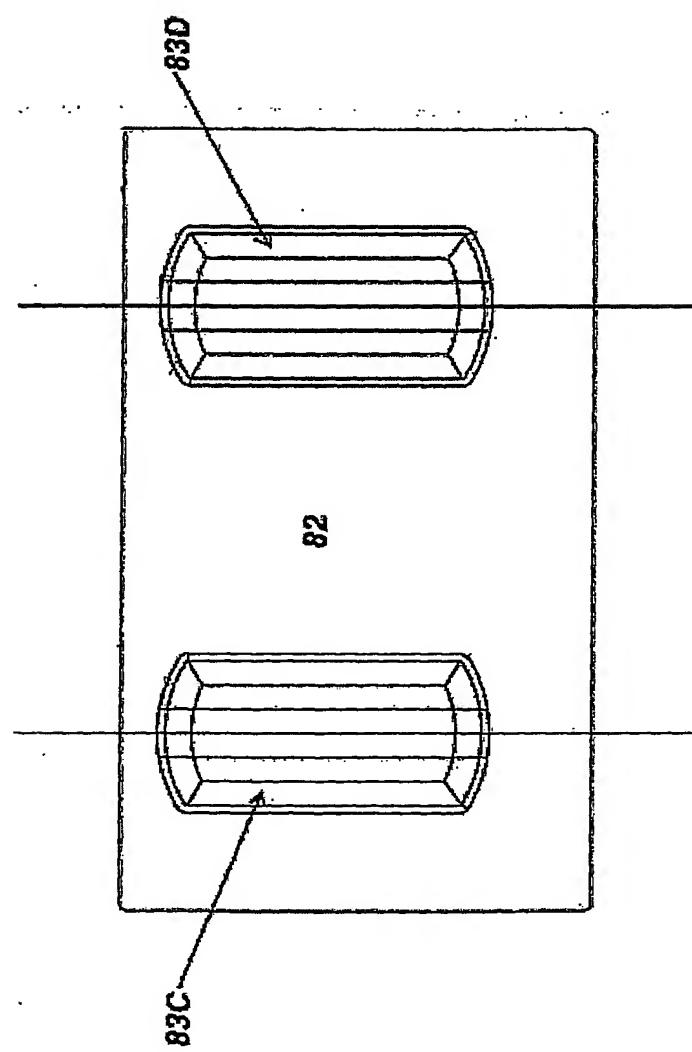


FIG 9G.

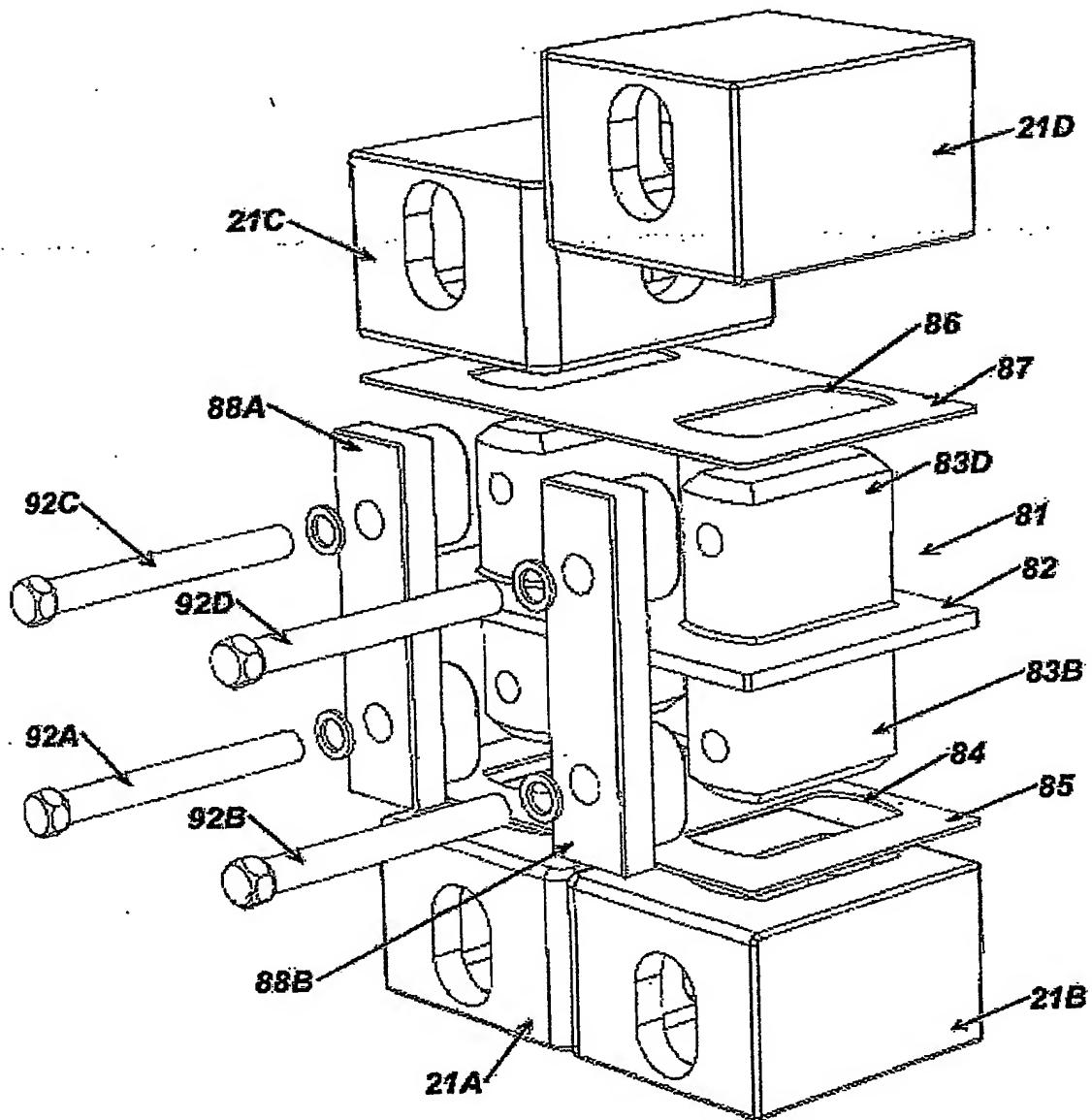
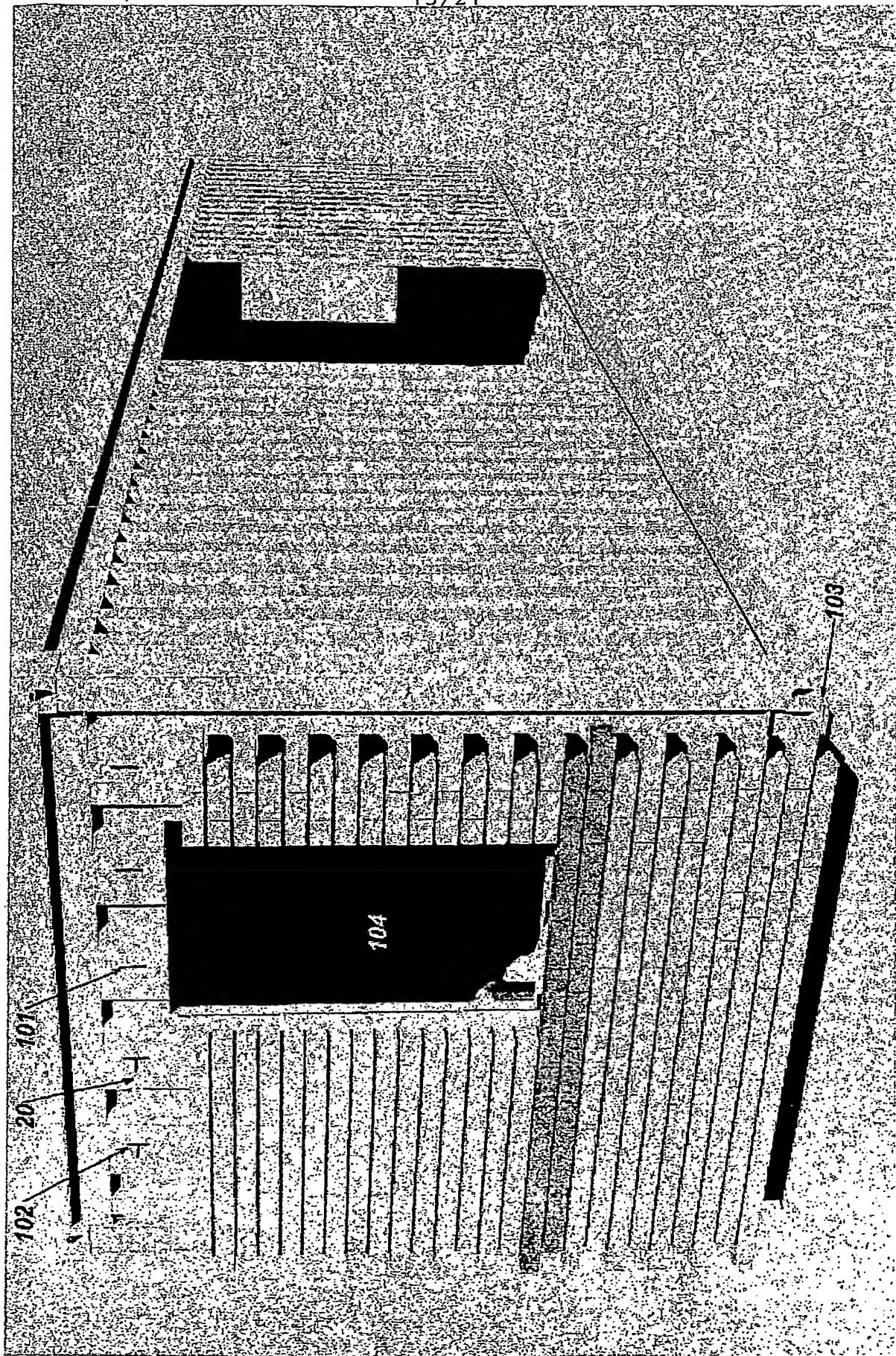


FIG 10



**FIG 11**

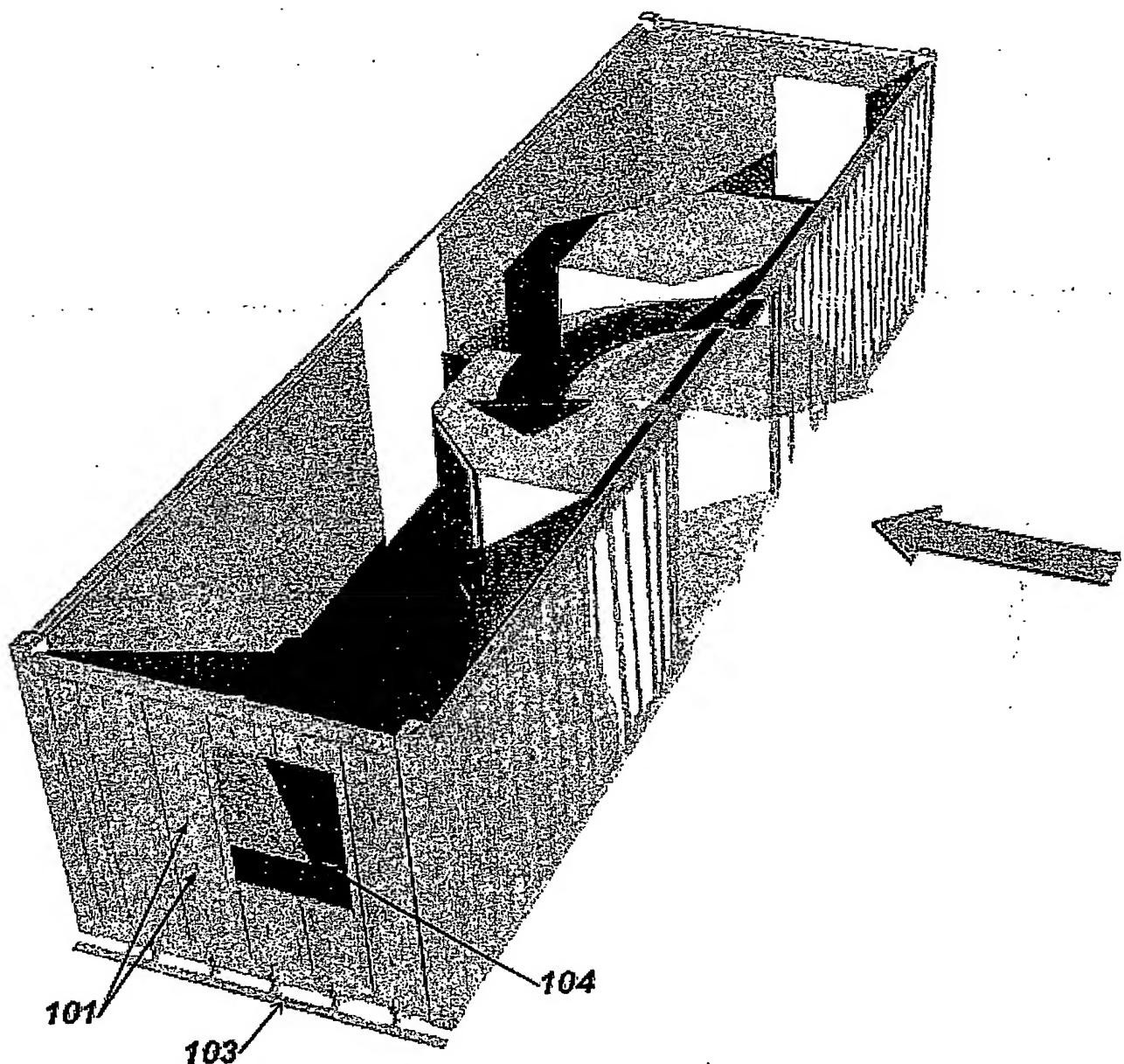


FIG 12

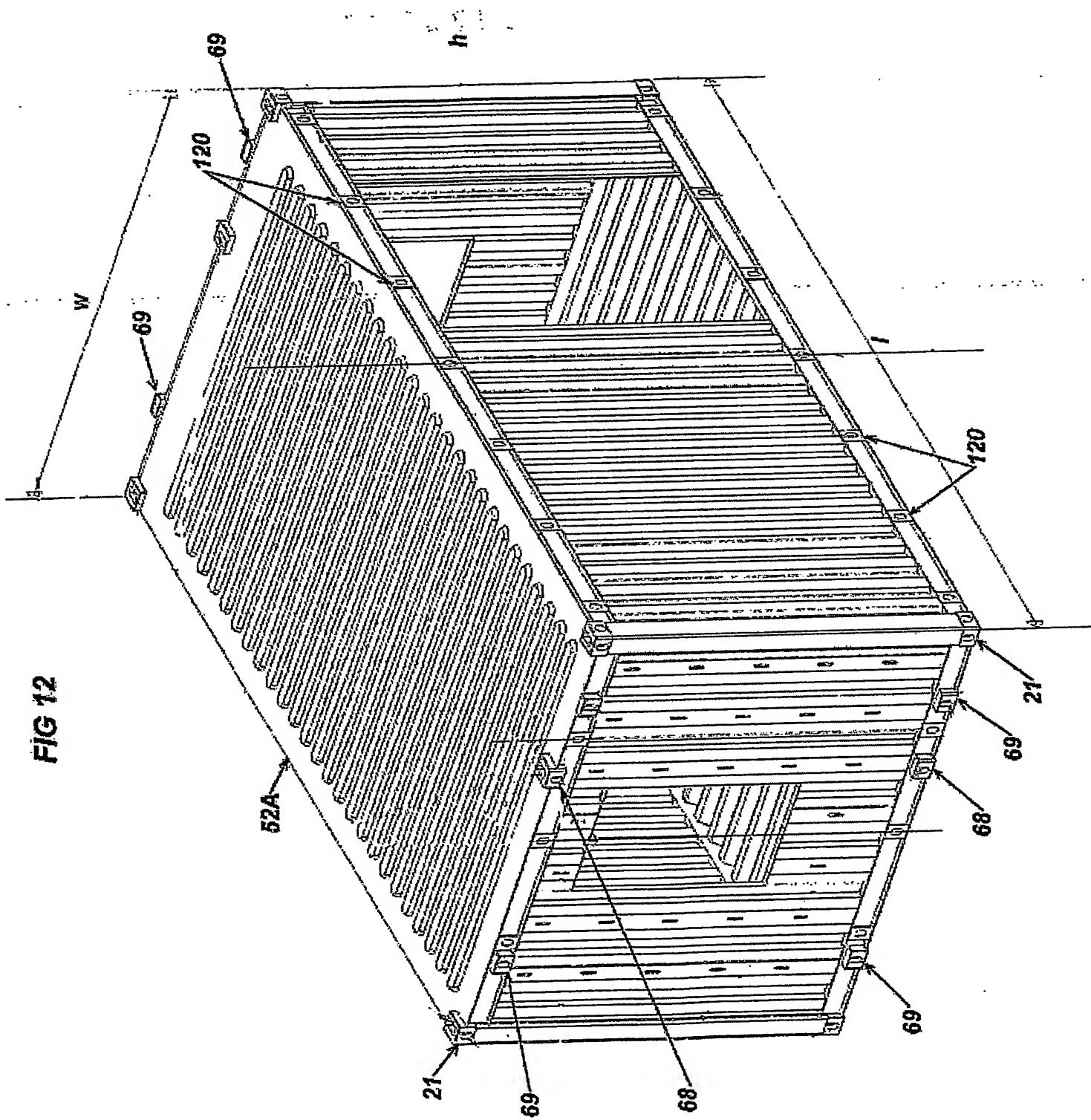
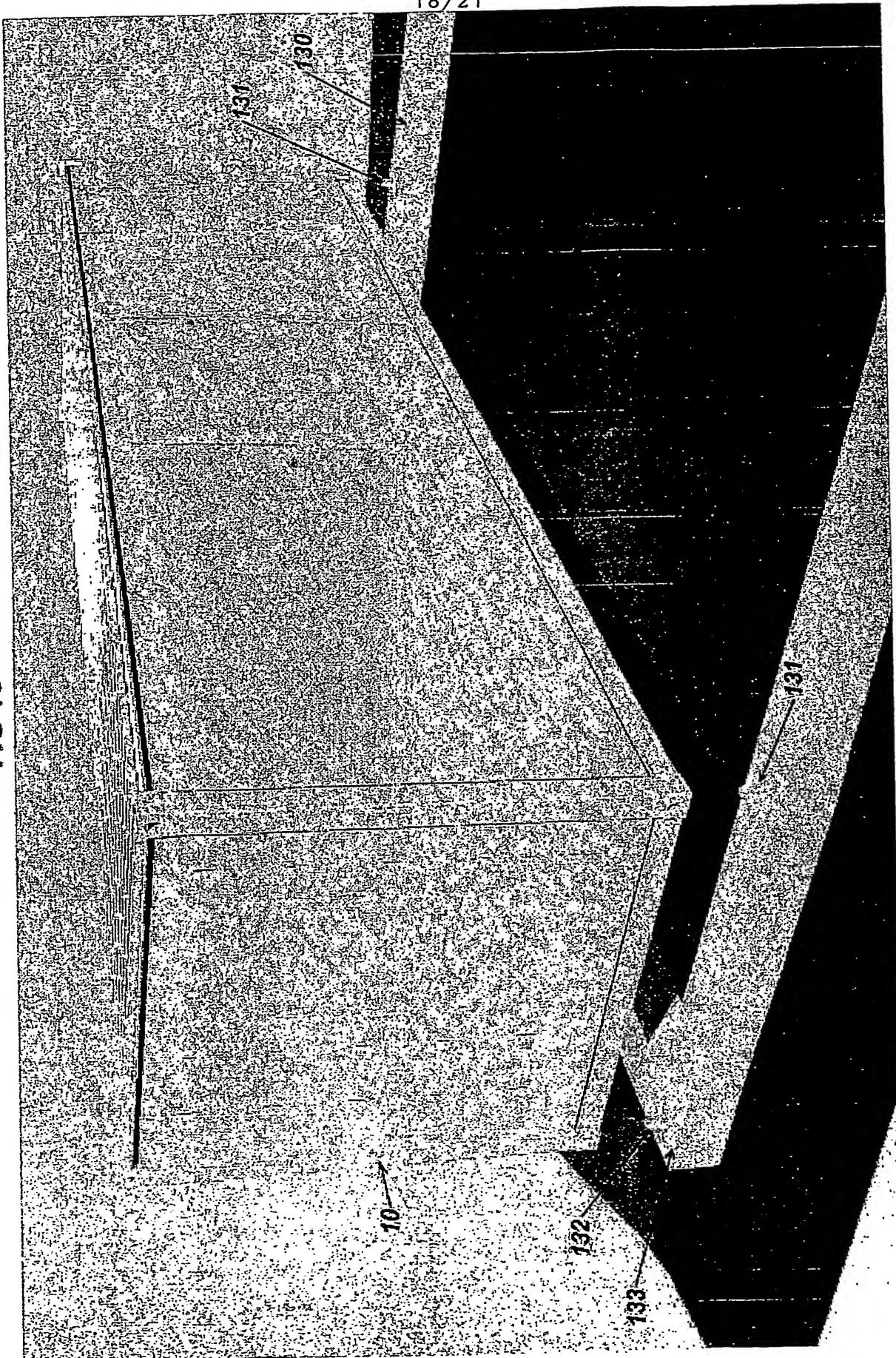
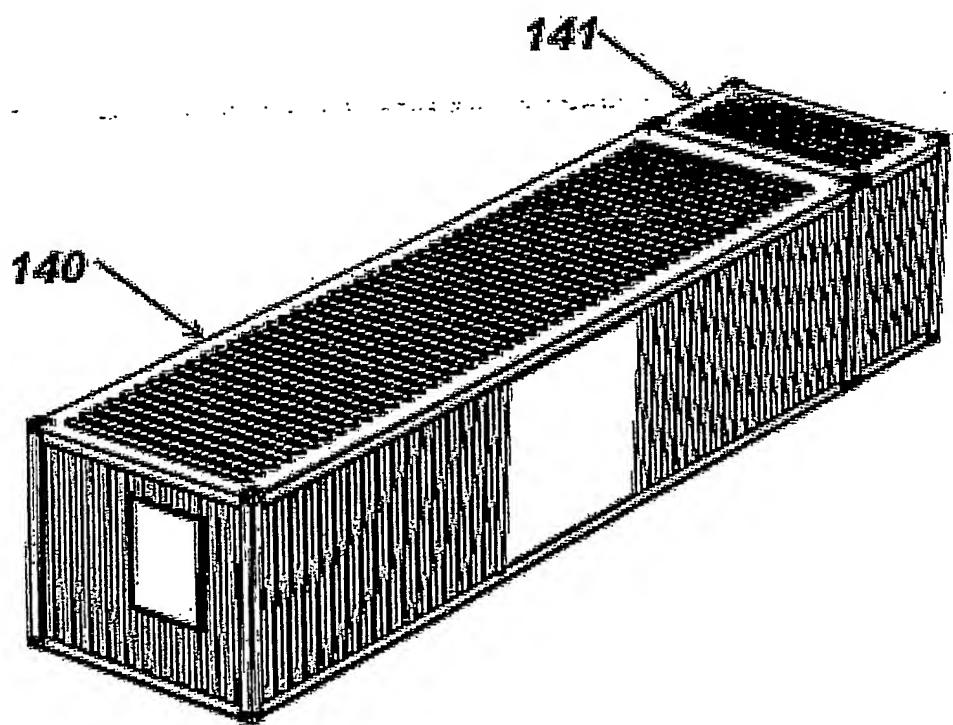
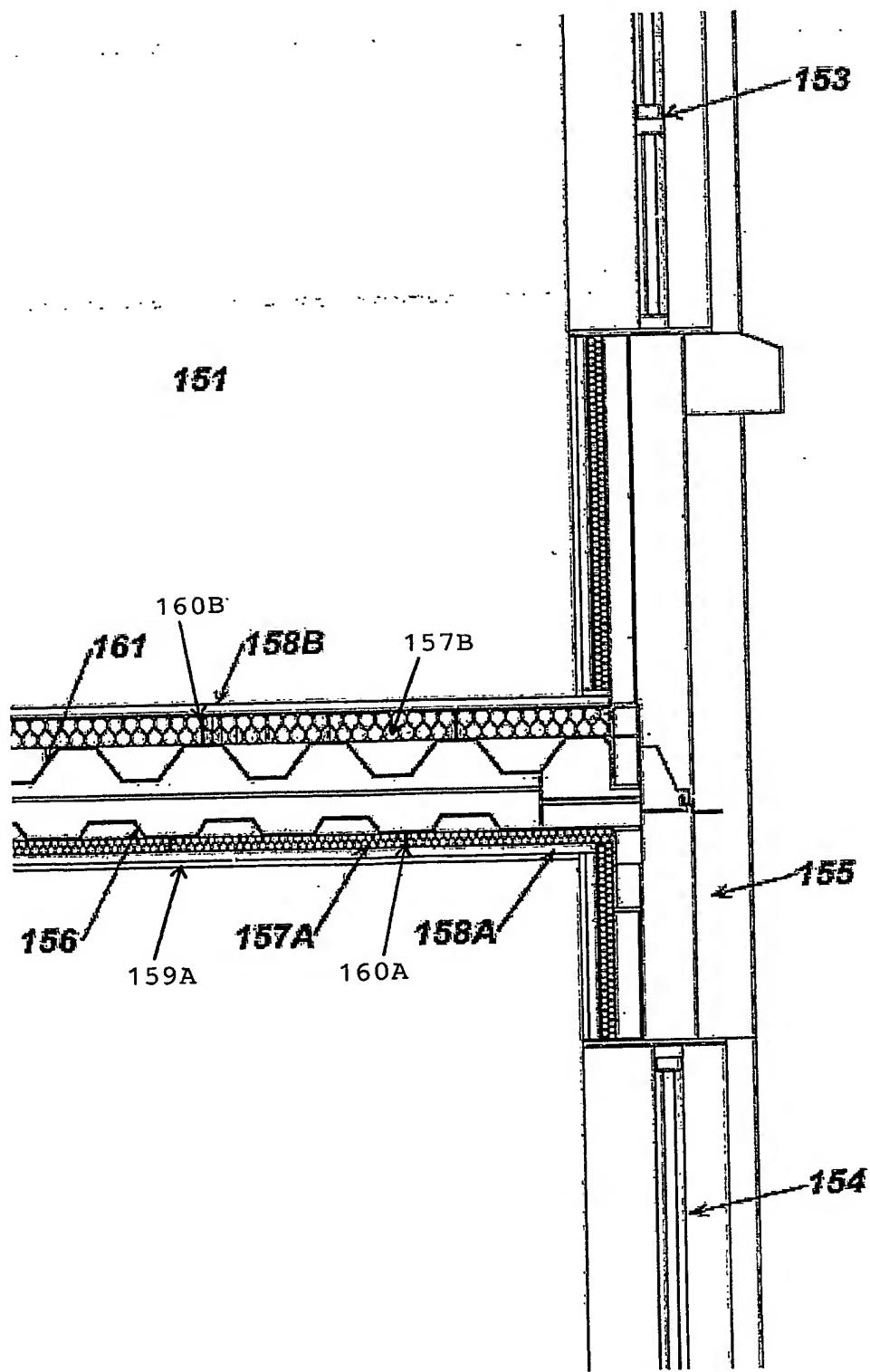


FIG 13

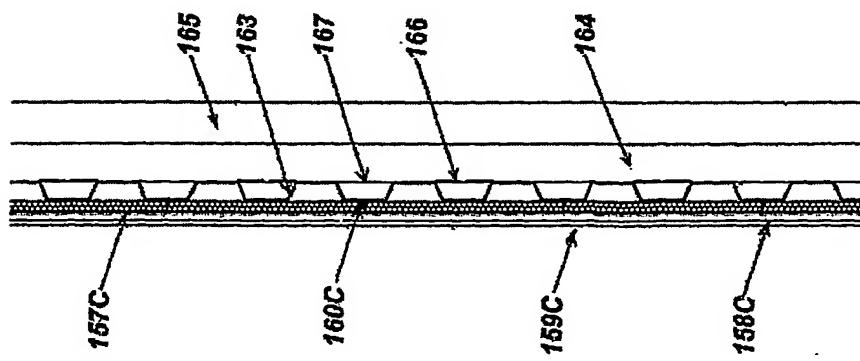


**FIG 14**

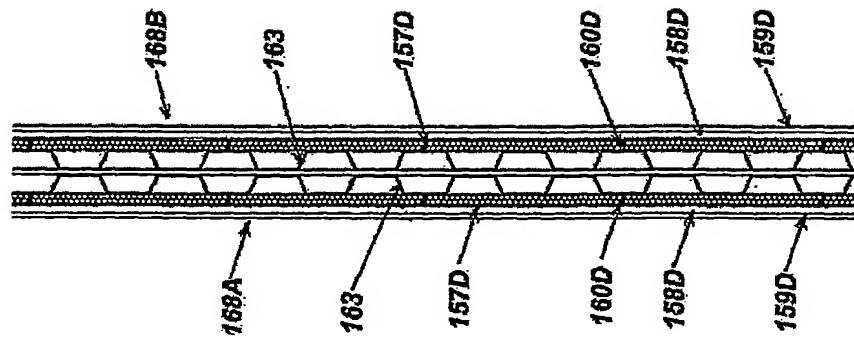


**FIG 15.**

**FIG 16A.**



**FIG 16B.**



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